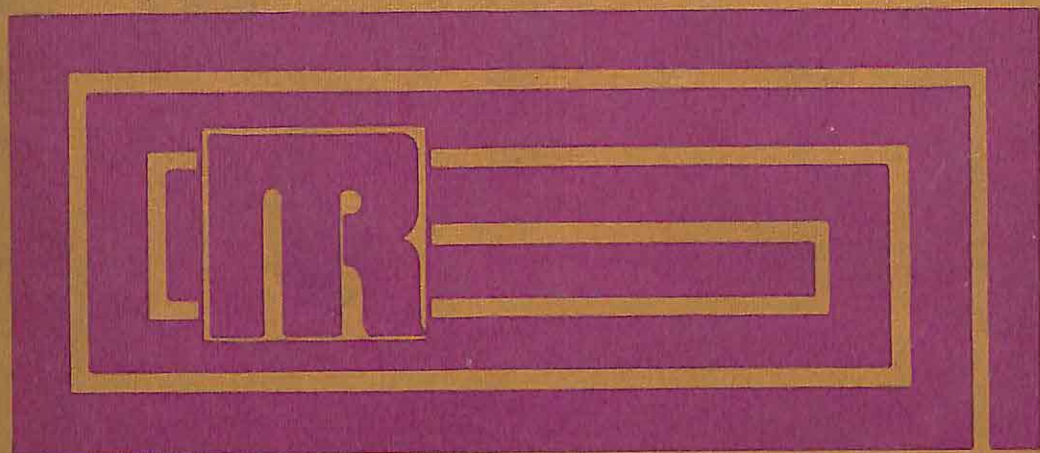


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**PICA
A Childhood
Symptom**

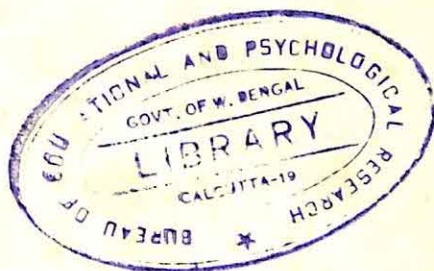
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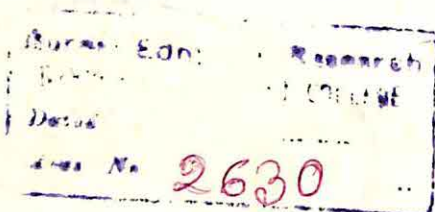
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PICA
A Childhood Symptom



Go to the people, live among them,
Learn from them, love them,
Serve them, plan with them,
Start with what they have,
Build on what they have.

from a Chinese poem
Anon

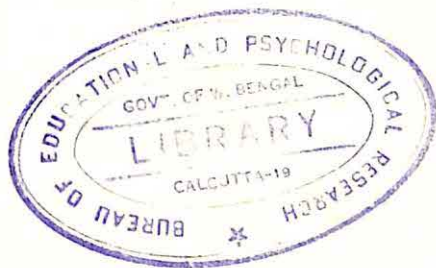


PICA

A Childhood Symptom

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**Sponsored by the Institute for Research
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First published 1975

© Butterworth & Co. (Publishers) Ltd. 1975
ISBN 0 407 35858 7

6.862
BIC

27.1.78
2630

Filmset and printed in England by The Camelot Press Ltd, Southampton

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Preface

Pica is a dangerous symptom because of the complications of poisoning and intestinal obstruction. A study both of children thought to be at risk and of children with severe pica was therefore considered a worthwhile contribution to the prevention of childhood disease.

Pica among hospitalized severely subnormal children was associated with low mental age, additional handicaps and behavioural disturbances. Selective and highly motivated pica occurred, suggesting not merely a developmental phenomenon but a maladaptive behaviour pattern to which inadequate stimulation may have contributed. Lead intoxication was common but not related to the cause of the mental handicap.

Children from deprived families, subjected to social disorganization, poverty and lack of parental supervision, were investigated, but pica and raised blood lead levels were universally absent.

A longitudinal study of children with severe pica revealed the multiplicity of handicaps, psychodynamic stresses and adverse environmental factors present at the onset of pica, usually one of several symptoms of a distressed, brain-damaged or retarded child. A pre-existing feeding disturbance was frequent. Accidental poisoning with lead and other substances occurred and several children were permanently impaired. There was no evidence from available data that iron deficiency was an important causal factor but was contingent upon the disturbed feeding pattern. Pica was controlled in most children by means of environmental manipulation and superficial psychotherapy.

D. J. B.

Acknowledgments

I am grateful for support and advice from Dr. Barbara Clayton, Dr. Brian H. Kirman and Dr. Jan Stern, psychologists, speech therapists and ward staff of Queen Mary's Hospital for Children, Carshalton, Surrey. In addition, I thank the various doctors who referred the subjects, the health visitors and nursery school staff who co-operated in the collection of personality profile data, the librarians of the Royal Society of Medicine, and Mr. T. Delves and staff of the Heavy Metals Laboratory, Institute of Child Health, London. I am indebted to Mrs. D. M. Quack for secretarial and general assistance, Mrs. M. Kaye for help with proof reading, and finally to the parents and children who made this study possible.

1

The Aims of the Study

The incentive to learn more about the aetiology of pica comes from the knowledge that children are still being damaged by lead intoxication and that lead is available to children with pica in a modern health-conscious environment such as ours. It is important that the intake of lead, a cumulative poison, is not accentuated by the exposure of children to unnecessary quantities of this heavy metal. Pica in childhood is a distressing symptom for parents, who, fearful of being found wanting in their child care practices, impose restrictions and punishments that are the antithesis of good child care. Pica is a symptom which adds stress to families that are already often stressed to the point of collapse.

The following seven hypotheses were constructed, each of which relates to a separate aspect of the aetiology and effects of pica.

(1) Pica is a symptom which may occur in a child as a response to internal or external stress or deprivation.

(2) Pica is a distorted developmental pattern of behaviour and is usually self-limiting. However, because of the dangers of accidental poisoning, especially by lead, therapeutic intervention is fully justified.

(3) While iron deficiency anaemia is common in children with pica, it is not always present, nor is it an important causal factor, but should be regarded as a frequent concomitant finding, associated with a global appetite disorder.

(4) Pica in the severely mentally subnormal child is not related exclusively to developmental level, but is frequently associated with behavioural problems.

(5) Pica may be selective and highly motivated even in the very handicapped.

(6) Lead poisoning following pica is an uncommon cause of mental handicap, but increased lead exposure frequently complicates established mental handicap.

(7) Pica and lead poisoning are seen more commonly in socially

2 THE AIMS OF THE STUDY

disorganized families because of the poverty of maternal care, lack of adequate stimulation and the ready availability of lead in old, substandard houses.

The author's study was undertaken with the aims of investigating these hypotheses and discovering which required further study.

The initial part of the study examined the characteristics of pica among mentally retarded children. The incidence of severe pica in a hospital population of severely subnormal children in long-term care was compared with that of a group of severely subnormal children living at home. The role of pica and lead poisoning was examined as a possible aetiological factor in the production of mental handicap. The child with pica was investigated from the clinical, psychological and biochemical aspects, and compared with other children in various sections of this highly selected hospital population.

The possibility of using random urine specimens on consecutive days and examining the lead concentration in these urine specimens following a small dose of an oral chelating agent was investigated as an alternative to a blood lead level and as a more sensitive indicator of the body load of lead.

The children in the wards for the severely mentally subnormal at Queen Mary's Hospital for Children, Carshalton, Surrey, were examined for this part of the survey.

In the second part of this study the children of families living at Frimhurst Recuperative Home, Frimley, Surrey, were investigated in an attempt to assess the importance of social disorganization in the aetiology of pica and lead poisoning. This is a unit to which local authorities send families for whom the usual social agencies can do no more. Efforts to rehabilitate them are made in poor but realistic surroundings. No direct teaching for the parents is given, but informal group therapy is the method whereby families regain their self-respect and their desire to adopt a better way of life. All families had severe problems in caring for their children and all children were, to some extent, deprived. Dirt, ignorance and neglect abounded.

Samples of painted wood scrapings were taken from various places which had been chewed by the children in the unit and analysed for their lead content.

The third and longest part of the study was devoted to a longitudinal investigation of an unselected group of 15 children referred because pica was one of their main symptoms. Fourteen lived at home, and the other child was in residential care. These children were followed up for periods ranging from 6 months to 5 years. Of particular interest was the evolution and cessation of pica and whether this was spontaneous or coincided with medical aid or social change, the association of feeding problems, the presence of handicaps both physical and emotional, episodes of acute accidental poisoning and the subsequent development of the child. The family background and general

pattern of care were also studied in numerous semistructured interviews, usually undertaken in the home.

The personality of the affected child was assessed by inventory technique and compared with a group of children of the same age without pica.

2

Review of the Literature

GENERAL INTRODUCTION AND DEFINITION

Pica may be defined as the desire to ingest and the ingestion of substances usually considered inedible, continuing beyond the normal developmental phase of occasional indiscriminate and experimental mouthing and swallowing.

Such preoccupation with oral activity may be detrimental to other spheres of psychological development or may result in poisoning: it is in contrast to the retention of pleasurable oral patterns of behaviour in the 'normal' child, such as thumb- and finger-sucking and the sucking of comfort blankets, both frequent features of self-comforting behaviour.

This symptom of pica is named after the magpie, whose Latin name is *Pica pica*, a bird notorious for its habit of stealing objects which cannot be regarded as food. Alternative words for pica used in the literature are 'geophagy', originating from Aristotle's word 'gephagy' meaning 'earth eating', and 'allotriophagia' which was originally used by Sophocles to mean 'eating another's bread' (Editorial, 1945). The word 'pica', because of its brevity and origin, is preferable to both of these.

Oral exploration is the first means used by the child and young animal to understand the outside world. Indeed, the survival of mammalian species depends upon the young finding the nipple soon after birth. In children these oral patterns of behaviour gradually become restricted to the feeding situation towards the end of the first year, when 'toys and hands, except when thumb sucking is a persistent pattern, go less frequently into the mouth' (Gesell and Amatruda, 1941). The normal child who is 10-18 months old is able to explore further into the external world because of increased mobility but may occasionally mouth objects as well as hearing, feeling and seeing them. Then the more aesthetic senses of hearing and vision and co-ordination of hand and

eye gradually predominate and by 2-3 years mouthing is no longer needed as a means of learning about the environment.

In some children this sophistication of exploratory behaviour does not occur, for reasons not yet clearly understood. Mouthing and swallowing inedible objects may persist and become more determined and occasionally more specific (Lourie, Layman and Millican, 1963). In other children pica begins in later childhood after a period when oral exploratory activity has been in abeyance.

THE PREVALENCE OF PICA

Pica is therefore considered to be a deviation from a norm of child development and there can be no sharp demarcation between the pathological state and normality. It is a subjective diagnosis and is usually made when the clinician is concerned that the child may become poisoned by lead or that intestinal obstruction or perforation may occur because of the unusual objects swallowed. The child who occasionally swallows paper and the child who persistently chews woodwork and picks holes in plastered walls so that structural damage is done, are merely extremes of a spectrum of this aspect of child behaviour.

However, studies in incidence have been made. Millican *et al.* (1962), in a study of children in Washington DC, aged from 1 to 6 years, found that 32 per cent of Negro children attending a hospital clinic or seen at home, and 10 per cent of white children attending a private clinic, had pica. Among the Negro population he excluded children with mental retardation, chronic illness and serious psychological problems. The incidence of pica fell rapidly with increasing age of the child so that by 6 years less than 10 per cent of Negro children had pica. An exact definition of pica was not given and these children were biased samples.

Barltrop (1966) studied a random sample of 716 white and coloured children in Boston and estimated the prevalence of pica and mouthing activity. He regarded pica as present if there had been ingestion of one or more 'non-edible' substances during the preceding two weeks; 18.5 per cent of children (white and coloured) studied by personal interview had pica, but this figure was higher for the families studied by postal questionnaire. There was a slight preponderance of coloured children with pica that was not statistically significant. A study of the siblings revealed a familial tendency to pica among the white children only. There was a decreasing incidence but increasing selectivity of objects mouthed or ingested as age advanced, suggesting that pica is an age-dependent developmental stage rather than an attempt by the child to correct a dietary deficiency by self-selection. The occurrence of pica was not related to the sex, family rank, size or social position of the family. Barltrop suggested that pica is not related to social or psychological problems in the

family, but is an oral developmental phase like thumb-sucking. It is probable that Barltrop included many children in whom pica was merely an occasional phenomenon and did not present a serious deviation from normal development.

A prevalence study by Cooper (1957) of 386 Negro children and 398 white children of similar age range showed that 27.2 per cent of the former and 16.8 per cent of the latter had pica. However, there was a bias in the selection of these groups which originated from referrals to a mental hygiene clinic because of minor behaviour problems or for paediatric supervision. The children came from predominantly working-class families and the housing was poor. A history of pica was asked for routinely in case history taking.

EARLY STUDIES LEADING TO CURRENT IDEAS

Anthropological studies

Anthropological studies have shown that habits such as earth and clay eating and the ingestion of laundry starch are common in certain areas of the world and may become part of the life of that population group. While laundry starch may have nutritional value, it is not considered as food and may therefore be regarded as pica activity. Such clay and starch eating may become accentuated, firstly in pregnancy, as shown by studies of the diet in under-fed pregnant women in Mississippi (Ferguson and Keaton, 1950), secondly, by poverty, among school children of the same area (Dickins and Ford, 1942), and thirdly, in extreme adversity such as the conditions of physical and emotional deprivation under which slaves were kept in South America (Galt, 1872).

Foster (1927), in a review of earth eating among animals and man in Africa, held the view that pica was a response to a physiological need and was related to growth periods such as childhood and pregnancy, and associated with malnutrition, high death rates and chronic morbidity.

Gelfand (1945), in an interesting survey of earth eating in Africa, suggested that the habit was widespread and was passed on from one generation to another because of the belief in the magical and spiritual properties of the earth and a genuine enjoyment of the habit rather than for any physiological necessity. Earth eating was used in ceremonials to appease the spirit of the earth and eaten by pregnant women to benefit the unborn child and to ensure a continuation of her fertility. The young baby was then encouraged to eat earth to encourage his own fertility. Gelfand believed there was no simple relation to malnutrition or infestation. He found that in different areas, different soils were chosen and men would walk miles for some of their favourite soil.

Spengler (1851) is quoted by other authors as one who described a practice in northern Sweden of mixing infusorial earth with the flour used to make bread, surely a custom maintained by preference rather than fulfilling a physiological need.

More recently, Layman *et al.* (1963) suggested that cultural influences were important in the development of pica among the children of 'southern' Negroes living in Washington, and that pica may be a learned pattern of behaviour.

Veterinary studies

Experimental observations from the beginning of this century have shown that animals may possess a remarkable ability to select a diet that ensures homeostasis and optimal development (Richter, 1942). Spontaneous selection of food to maintain health and growth continued following experimental adrenalectomy, subtotal pancreatectomy, hypophysectomy and when insulin and thyroxine were given. A complex mechanism appeared to be present whereby food intake was modified according to the changing needs of the body. Occasionally this seemed inadequate, such as when rachitic rats failed to seek out extra vitamin D, and when well established food preferences obscured the search for physiological necessities after an operation such as adrenalectomy (Donhoffer, 1960).

These experiments aroused great interest and similar aetiological theories were constructed for pica in children.

However, observations in the field have not been so easily interpreted. Some animals appear able to correct their deficiencies by choice of food intake, others do not do this, some will eat soil of no apparent nutritional value, and others will poison themselves by over-indulgence.

Foster (1927) reviewed the experimental evidence and anecdotal material that suggested that pica in animals was due to a selective deficiency in the diet. For example, phosphorus-deficient animals will seek bones to chew, pigs develop coprophagia if deficient in calcium and phosphorus, sheep eat their own wool if on a 'faulty diet' and salt-deficient mountain sheep lick the perspiration of mountaineers.

Mathieu (1954) showed that cattle with pica and osteomalacia, lacking in calcium, phosphorus and vitamin D because of deficient soil, could be cured of both pica and osteomalacia by improving the phosphate content of the soil on which the hay crop was grown.

However, some animals on deficient soil may not eat earth when given soil known to cure their particular deficiency, while others in the same group will do so (Rigg and Askew, 1934).

Careful analysis of soil has suggested that in many instances animals eat earth that has no detectable nutritional value. These soils are often known locally as 'salt licks' but are frequently found to contain only insignificant amounts of salt. However, many African herdsmen regard such periodic earth eating by their herd as essential for the maintenance of health and fertility in their stock (French, 1945).

Craving for substances by animals in which the diet is not deficient can result

in disease; for example, that due to the excessive intake of selenium (Miller and Williams, 1940).

The present status of veterinary opinion is one of doubt and debate. While there is evidence of the efficacy of self-selection and the ability to replace dietary deficiencies in a way that may involve pica activity, this ability is not universal nor is a pre-existing deficiency state always identifiable. Furthermore, if pica is long-standing it may remain as a habit even after a deficiency state has been corrected (Stirk, 1969, personal communication).

Medical studies

During the last 100 years there has been a gradual understanding of pica as a psychological, medical and social problem.

Thomson (1895), in a study of pica and its causes, divided children with this 'morbid craving' into two groups. One comprised those in which the habit coincided with some marked deterioration of general health, of which anaemia was usually a symptom, the pica diminishing if the general condition improved. These children were cachectic and suffered from a variety of conditions, some incurable. The second group were those with no cachexia in whom the habit had persisted from early infancy, spontaneous remission occurring at about the age of 3 years. Koplik (1918) struck a moralistic note in describing pica as an exaggeration of a normal habit in children in whom 'a sense of wholesomeness is lacking'.

Ruddock (1924) stated that, while pica was known to occur commonly in the latter half of infancy, it sometimes began in later childhood 'when from any cause the general health fails and the child becomes anaemic'.

A broader view of the aetiology was expressed by Smith (1931). After describing a case of an under-nourished, neurotic 3-year-old girl who swallowed hair, he concluded 'pica may be considered as a bad habit such as thumb sucking, nail biting, masturbation and some cases of enuresis, in which bad feeding, lack of training, poor surroundings and limitation of interests all play a part'. Burrows, Rendle-Short and Hanna (1951) described five cases of lead poisoning in which pica was thought to be the cause. They stated, 'pica may result from gastro-intestinal disturbances, mental deficiency, neurosis or simple habit'—a blanket definition covering physical illness, psychological disturbance and normality.

Subsequent medical and psychological studies have increased our understanding of this symptom and are described below (see 'The aetiology of pica—present theories').

THE RELATION OF PICA TO LEAD POISONING

The clinical aspects, the epidemiology and the social problems of childhood lead poisoning became increasingly apparent during the first half of this

century and clinicians became aware of the severity of brain damage that may follow such poisoning.

As early as 1924 Ruddock described two cases of pica for painted wood resulting in lead poisoning and emphasized the change in disposition as a frequent symptom of this condition. He was probably the first to state that pica is one of the most important aetiological factors in lead poisoning in children. He stressed the danger of easily available lead-containing paint on window-sills and porch railings. Lead was also present at that time in bakery products, sweets, milk, water, ointment and medicines. He rightly stated that 'a child lives in a lead world'.

The problem of lead poisoning in Queensland, Australia, was also reviewed at this time with a view to imposing prohibition on the lead content of paint (Article, 1922). Powdering lead paint on veranda railings was found to be one cause of the high incidence of lead poisoning during the summer months, the hot sticky hands of children transferring to their mouths the paint which powdered in the sun. An association with finger-sucking and nail-biting was noted, and often only one child in the family would be affected.

During this era and until the early 1950s blood lead levels were not universally available and the diagnosis of lead poisoning was a clinical one, aided by such inconsistent findings as basophilic stippling, lead lines on gums and anaemia. With the advent of efficient laboratory methods for the estimation of lead concentration in blood, urine and paint scrapings, investigations into the problems of lead ingestion were made easier and the epidemiology of such poisoning was more clearly defined.

Numerous studies have shown that children with pica run a high risk of lead poisoning. Similarly, lead-poisoned children are found to have a high incidence of pica. This would probably be 100 per cent when such accidents as inhaling fumes from burning battery cases (Turner, Bamford and Dodge, 1967) and lead paint sprays are excluded.

Greenberg *et al.* (1958) studied a group of 194 children with pica and found that, of these, 28 had raised blood lead levels and 20 more had borderline raised blood lead levels, suggesting that approximately 1 in 4 children with pica runs the risk of developing lead poisoning if there is lead in the environment.

Berg and Zappella (1964), in a review of the British literature concerning pica and lead poisoning, examined 36 case histories of lead poisoning, and pica had been noted in 21 (62 per cent). Paint and lead toy soldiers were the most common sources of lead. In a Chicago series of childhood lead poisoning cases the incidence of pica was 94 per cent (Tanis, 1955) and in Washington (Cohen and Ahrens, 1959) the incidence of pica was 93 per cent.

Faecal lead studies on 2-year-old children with symptomatic lead poisoning suggested that this may result from the daily ingestion of 1–2 mg of lead for 5–6 months (Bartrop and Killala, 1967).

The raised incidence of lead poisoning in the summer months has been

examined by many workers; Chisholm and Harrison (1956) studied 197 children with lead poisoning and showed that most cases occurred in the summer. Similar results have been obtained by other workers in the USA (Lewis, Collins and Wilson, 1955; Tanis, 1955; Baetjer, 1959; Benson, 1962). In Britain, Oliver (1967) reported that serial blood lead levels taken during a period of 12 months from hospitalized psychotic children with pica, showed a marked rise during the summer months, although in many of the children these increases were unaccompanied by clinical symptoms.

While the possibility of seasonal variation in pica activity has been considered particularly in Australia, there is little evidence that this is the sole cause for the summer 'epidemics' of lead poisoning in Britain or in the USA. Rapoport and Rubin (1941) have produced elegant experimental evidence that rats are more readily poisoned by ingested lead when vitamin D is given as well, or when the exposure to sunlight is increased. It is therefore suggested that the increase in lead poisoning in summer months is due to a greater absorption of lead from the bowel, probably related to raised vitamin D levels in the body due to exposure to longer periods of sunshine.

THE AETIOLOGY OF PICA—PRESENT THEORIES

Current theories on the aetiology of pica can be divided broadly into social, psychological (including mental subnormality) and physiological theories.

Social theories

Many studies have emphasized the high incidence of pica and lead poisoning in the environment of low socio-economic status groups where there was easy access to flaking paint in dilapidated houses (Jacobziner and Raybin, 1960). Frequent concomitants of such an environment are large families, uninformed parents and inadequate child care. All these factors are said by various authors to be significant in the aetiology of pica. Griggs *et al.* (1964), in a study of 906 children between ages of 1 and 5 years in Cleveland, Ohio, found that 27 per cent of children living in old houses had raised urinary lead levels, but only 3 per cent of similar children of the same social class housed on a new estate were affected. Unfortunately, the incidence of pica was not investigated, but one suspected that the reduction in the number of children with raised urinary lead levels was due mainly to a reduction of lead in the environment and not to any alteration in the habit of pica. In a study by Barltrop and Killala (1969) of the lead content of paint scrapings taken from 56 houses built at different times and inhabited by families of varying social class, 53 per cent of the samples contained more than 1 per cent of lead and a quarter of these contained more than 5 per cent of lead. Old houses and lower social class families were most frequently associated with indoor paints of high lead content.

Kanner (1957), in a textbook review of pica, probably over-simplified the

aetiology and stated that pica was seen in malnourished, poorly supervised and neglected children, illustrating this by short case histories all with poor social backgrounds. He distinguished pica from addictive types of craving because he believed that pica ceased with improved supervision.

Bradley and Bessman (1958) also emphasized the high incidence of pica in poor areas such as the one he investigated in Baltimore, Maryland; 69 per cent of the 333 children selected at random had pica, mainly for paint and plaster, and 44 per cent of the total had raised blood lead levels. Raised blood lead levels probably give an indication of the incidence of pica at different ages; the peak blood lead level was at 2 years, the time, the authors suggest, when the child is confined to the house, when there is a great need for oral gratification and, in a crowded home, poor parental supervision and few opportunities for self-assertion. He also found the parents ignorant of the hazards of pica.

Most studies have emphasized how the social and psychological problems are closely interwoven. In Chisholm and Harrison's (1956) study of children with lead poisoning, their findings suggested that pica was related to the parental lack of awareness of the dangers involved and inadequate parental supervision. There was some evidence from observation of these children when hospitalized that pica was an attention-seeking device, and the high incidence of working mothers and families with several young children suggested that this was so. Increased parental attention following the illness was associated with a striking diminution in the habit of pica.

In an intensive study of lead poisoning in New York City, Jacobziner (1966a) concluded that this type of poisoning was inextricably linked with poor housing and home disorganization. The families with affected children were almost all from the lower social classes; 30 per cent had no father, and in 22 per cent of families there were additional medical problems. These were higher figures than for the general population in the same district.

Psychological theories

Developmental studies and family dynamics

Various workers have stressed that there are more factors in the aetiology of lead poisoning than the conditions of housing. The siblings of a poisoned child living in the same dilapidated house and many families in equally bad housing are sometimes entirely unaffected, and, conversely, some cases of lead poisoning occur where the housing and family situation appear to be good (Tiboni, 1964).

Mellins and Jenkins (1955; Jenkins and Mellins, 1957) studied the epidemiological and psychological problems of 46 cases of lead poisoning, all showing pica. Details were collected of family background, the child's early development, emotional stability, performance in psychometric tests and the Vineland Social Maturity Scale. Observations during play and a medical examination were also made. All the families came from the lowest socio-

economic group and the conditions found in these families were not unusual for their social class. There was a mean of four children to each family. Supervision by some parents was limited either by low intelligence or interpersonal conflicts within the family. The parents lacked knowledge of the dangers of lead paint, and there was little opportunity for varied play. Pica, present in each poisoned child, probably started soon after walking and the parents' comments suggested that pica was a strongly motivated and aggressive behaviour pattern rather than a random activity. It was difficult to distract the child to more acceptable pastimes and punishment was of little value. Furtive scavenging because of an awareness of their wrongdoing was also noted. The medical histories prior to the illness were unrevealing but emotional disturbance was common and a few were mentally retarded. There was no evidence that these children had nutritional inadequacy and there were no cravings or food preferences that characterized the whole group. Early feeding experiences were not remarkable, but some difficulty in weaning was noted and soft diets had frequently been given. Toilet training showed 'no consistent deviations from the average'. The authors concluded that a better standard of emotional health of children would be essential for the prevention and control of pica.

Millican, Lourie and Layman (1956) studied a group of 6 children with lead poisoning and the factors which led to the persistence of oral activities beyond the normal developmental period. The study consisted of case histories, playroom interviews, psychological tests and psychotherapy for mother and child. They elicited three main factors: firstly, a disturbance in the mother-child relationship, which may result from emotional problems of the mother, separation from the mother, or simply a lack of good personal relationship with the child; secondly, the presence of organic brain damage; and thirdly, economic and cultural factors such as poor housing, the use of lead-containing paint indoors and poor standards of supervision and care of the child. It was stressed that these factors were inter-related; the organically damaged child has a greater dependency need on the parent and, if this need is not met, the child persists with oral activity for satisfaction. Such a situation may follow an episode of lead poisoning when organic brain damage occurs and an initially distorted mother-child relationship is put under even greater strain because of the increased needs of the child. Psychiatric study of the mothers showed a predominant pattern of immaturity with difficulty in interpersonal relationships. Most were excessively dependent on others; all were insecure and showed strong hostile drives.

In a later publication by the same authors they extended their psychiatric studies to a group of 32 children with pica, 21 of these having had lead poisoning (Lourie *et al.*, 1958). Factors held responsible for the onset or persistence of pica were separation from mother and/or father in 20 cases and the birth of a sibling in 7; 27 children were found to have associated habits of

hair-pulling, scratching, nail-biting, and so on. It was suggested in psychoanalytical terms that the loss or inevitable sharing of a loved object produced internalized hostility which resulted in pica. In 26 children the pica was selective or fairly selective but in those children where pica was indiscriminate, brain damage was more evident. Psychiatric studies of the mothers distinguished three main personality types: firstly, those who were unable to meet their child's needs because of a relationship of aggression with the child; secondly, withdrawal of the mother or concern over her own dependency needs resulting in ineffective communication with the child; and thirdly, poor impulse control in the mother associated with the same deficit in the child. In the same paper the authors related their findings for pica to the psychodynamic pattern of addiction to alcohol or drugs, which they described as 'the striving for security combined with the desire for satisfaction', and suggested that children with pica might be considered addicts. There is, however, inadequate evidence that pica is a form of addiction or that it occurs most often in addiction-prone families.

The possibility that pica may be a perverted appetite in a child with feeding problems was viewed by Cooper (1957) in a developmental and psychological perspective. There was found a greater incidence of feeding problems (faddiness, food refusal, food obsessions, etc.) in the group of children with pica (63.3 per cent) compared with the control group (39.7 per cent). Appetite is a complex physiopsychological concept affected by physical needs, emotional state, daily activity, habit and fatigue; methods of satisfying appetite vary according to cultural and economic patterns. The young child's urge towards independence leads to resistance to being fed, the desire to finger-feed and eat at irregular hours. Cooper suggested that if such 'disorganized' feeding were allowed, the child would learn to select an adequate diet and gradually conform to family requirements. If, however, his attempts at independence were resisted, a frustrated child with a feeding problem and eventually pica might result. Sweet (1936) has emphasized that parental rigidity may easily lead to the development of perverse habits and chronic anorexia in children. The child's ability to select an adequate diet and the ease with which conflict over feeding thrives in an atmosphere of faulty family relationships have both, in his opinion, been under-estimated. If these hypotheses are relevant, then an understanding of the feeding habits and tastes of the young pre-school child may be considered an important prophylactic measure in avoiding dietary difficulties of which pica may be one.

Woody (1971), however, prefers to view pica as a learned maladaptive pattern of behaviour. He suggests that pica is initially perhaps a chance activity but rapidly and positively reinforced by reactions of parents and doctors until it is so well established that behavioural modification techniques combined with environmental change and possibly psychoanalytical counselling may be required for the pica to cease.

Psychoanalytical interpretations

Mouthing and swallowing of objects devoid of nutritional value is regarded by analysts as a normal stage in the development of the young child, who not only attains satisfaction, but also acquires by way of the mouth knowledge of the ego-foreign outer world.

Case descriptions involving psychoanalytical concepts of pica are few: the interpretations by Lourie *et al.* (1958) have already been mentioned. Van der Sar and Waszink (1952) in the Netherlands, reported the case of a 5-year-old illegitimate Negro boy cared for in a neglectful way by his grandmother. He ate stones in great number, but only from his mother's garden. The explanation given is that resolution of his oedipal conflict had been frustrated and he sought substitute satisfaction by eating stones from the garden of the one person he wanted but could not have. His attitude to the world was described as ambivalent, a feeling of hatred combined with a need for satisfaction. These, together with neglect of the child, resulted in pica. It has been pointed out by Abraham (1949) and other analysts that the love for somebody is closely linked with the desire to incorporate (ingest) the object of love.

The relation to subnormality

Pica may be considered as either a causal or a concomitant finding in mental retardation. Those workers who emphasize that pica may be a causal factor in the production of mental subnormality suggest that brain damage may be the result of lead poisoning and that the children were relatively normal before the poisoning apart from the habit of pica, for which the cause was uncertain.

There are others who emphasize that pica is a common symptom in subnormality and has little to do with the cause of the mental handicap. The mentally retarded child, brain damaged because of other factors, will remain at a more infantile developmental level for a longer time than the normal child, and this, combined with relatively more advanced locomotor ability, may accentuate the problem of pica and lead poisoning may be superimposed on the existing brain damage (Bicknell, 1967). It is still not known whether a moderately raised blood lead level, associated with persistent pica in a severely subnormal child, causes any further mental deterioration although anecdotal evidence suggests that this may be so.

Studies documenting the importance of pica leading to lead poisoning as a cause of mental retardation are numerous but, because the studies are retrospective, the assumed normality of the child prior to the poisoning is usually based only on the history from the parents. However, in Cooper's study (1957), where lead poisoning did not appear to be a major problem, the intelligence of 151 cases of pica and 522 control children from a similar environment was assessed and the majority of each group was in the dull normal range. Byers and Lord (1943) stressed the serious late effects of lead

poisoning on mental development in an era when treatment was not as satisfactory as it is today. In the study by Mellins and Jenkins (1955) of 15 children with lead poisoning who survived and were available for follow-up, 1 was retarded in motor development prior to the poisoning, 3 were slow in speech development and 6 were emotionally unstable. After the lead encephalopathic illness, 14 were mentally retarded (IQ below 79). A prolongation of this study comprising 46 cases of lead poisoning (Jenkins and Mellins, 1957) showed that, of the 33 surviving children, 27 were retarded following the episode of poisoning and in 20 of these the retardation was ascribed to the lead poisoning. Follow-up over 2 years suggested a trend towards incomplete recovery.

However, there have been more optimistic papers, such as the one by Bradley and Baumgartner (1958) where 18 children with lead encephalopathy, treated with BAL (2,3-dimercaptopropan-1-ol) or calcium EDTA (calcium disodium ethylenediaminetetra-acetate) responded well and at follow-up 2-5 years later showed little evidence of mental impairment. Another much larger study of 425 patients with lead poisoning, by Perlstein and Attala (1966), showed that, with treatment, 61 per cent made a complete recovery. However, the incidence of mental retardation or epilepsy when acute encephalopathy with survival had occurred was 82 per cent, thus emphasizing the importance of early treatment in the prevention of brain damage. It would appear that the prognosis for mental development may be poor if diagnosis is delayed or a second episode of lead poisoning occurs (Chisholm and Harrison, 1956; Byers, 1959).

Individual cases have also been documented; Berg and Zappella (1964) quoted a case of lead poisoning in a 2-year-old boy who ingested garden soil contaminated with lead. Acute lead encephalopathy resulted in severe brain damage and the boy recovered, only to function at a very low level. He was left on his own for hours in the garden, and boredom may have precipitated pica in this otherwise normal child.

Pica resulting in lead poisoning does not seem to be numerically important as a cause of brain damage when surveyed against the whole field of aetiological factors in mental handicap. Perhaps the highest figures are quoted by Woods and Walters (1964) in the study of 30 mentally retarded children selected because of intellectual deterioration and the presence of pica or cerebral palsy. Lead poisoning was implicated in 3 as the possible primary cause of the brain damage. However, in a study by Donoghue (1968, personal communication) of aetiological factors in the symptomatology of 300 children who attended a psychiatric and subnormality clinic, no case of lead poisoning was diagnosed.

The incidence of pica among the severely subnormal varies between different studies, probably because of the difficulty in defining the symptom.

A study conducted by Oliver and O'Gorman (1966) with 40 long-term care

hospitalized psychotic children showed that 26 children (65 per cent) had pica and, of these, 17 (43 per cent) indulged in pica activity each day. The incidence of raised blood lead levels presumed to reflect the frequency of pica among populations of mentally retarded children has been the subject of several studies. Moncrieff *et al.* (1964) found that, of 122 children with mental retardation or severe behaviour disorders, 45 per cent had blood lead levels above the upper limit that he considered normal for children (36 $\mu\text{g}/100\text{ ml}$). Of the 30 mentally retarded children investigated by Woods and Walters (1964), 40 per cent had raised blood lead levels; Oliver and O'Gorman (1966) found similar results in 58 per cent of 40 retarded children. In part of a study by Gibson *et al.* (1967), 6 (30 per cent) of a group of 20 ambulant mentally retarded children had raised blood lead levels, and all of these 6 had pica. In a less well documented study, Gordon, King and Mackay (1967) failed to show a raised incidence of increased blood lead levels among 147 mentally retarded children compared with 73 controls. It is disturbing to note that 16 per cent of each group had raised blood lead levels by their laboratory standards.

Physiological theories

Iron deficiency as the cause of pica

The relation of pica to iron deficiency is a controversial one. Following the veterinary studies on the self-selection of necessary dietary constituents by animals and the results of study of self-selection of diets by children (Sweet, 1936; Davis 1934, 1939) the idea of the child developing pica in an effort to correct a specific deficiency such as iron in the diet was an attractive one. The idea was, however, not new. There are, for instance, many early references to the association of pica and iron deficiency anaemia. In 1876 Gould published a case of pica cured by iron therapy; Hancock (1831) attributed pica to 'paucity of good blood and lack of proper nutrition'.

Lanzkowsky (1959) published a series of 12 cases of children with pica in South Africa. All had an iron deficiency anaemia (mean Hb 7.89 g/100 ml, with a range of 3.0–10.9 g/100 ml). In every child, pica was cured by intramuscular iron therapy. Carlander (1959) stated that pica depended entirely on sideropenia and that iron therapy produced a cure in every case. In a study of 14 children with pica in Israel, Ber and Valero (1961) attempted to show that these children had lower haemoglobins than expected and were cured with iron therapy. The children were not thought to be backward and behaviour problems were said to be uncommon. In some, refusal of food was noted. The methodology of both the paper by Lanzkowsky and that of Ber and Valero can be criticized; there were, for instance, no controls in either series. In the paper by Ber and Valero there were no haemoglobin results after treatment, many cases were lost to follow-up and all those who were followed had good results, suggesting that those who did not improve failed to return. Almost all

the children had unexplained hepatosplenomegaly and some siblings had lower haemoglobin levels than those with pica.

Gleditsch (1959, 1960) published similar results in Norway of an uncontrolled study of 20 cases in which pica associated with iron deficiency was cured by iron therapy or blood transfusion. However, the cure was so rapid following administration of iron either by mouth or by injection that he suggested that the cause of pica was related to the interference with epithelial surfaces and erythropoiesis caused by iron deficiency and not to iron deficiency anaemia alone.

Catzel (1963) investigated 36 children in South Africa, from middle class families in good housing, with pica for sand. The average age was 15 months. They drank excessive quantities of milk, refused solids, were anaemic and were cured by being given either intramuscular or oral iron. The title 'milk poisoning syndrome' was suggested, an inaccurate term for an ill-defined condition. There were no controls in this series, either.

An interesting case was reported by Chamberlain (1965) of a 4-year-old girl with pica and severe anaemia due to a bleeding intestinal polyp in which intramuscular iron brought about a temporary cure and removal of the polyp by surgery and correction of the anaemia, a permanent cure.

A Leading article (1959) in the *Lancet*, summing up Lankowsky's and Cooper's work, suggested a strong causal association between iron deficiency and pica. Jolly (1963) also stressed the role of iron deficiency in the causation and the value of intramuscular iron in treatment of pica.

Iron deficiency as the result of pica

Several workers have suggested that iron deficiency anaemia may be the result of pica rather than the cause (Tevetoglu, 1961). Weippl (1959) quoted four cases of young children where the anaemia was cured either by iron or spontaneously once the pica had stopped. Barltrop (1959) described the case of a child with pica and anaemia; the pica stopped and her appetite improved on admission to hospital before treatment of her anaemia had started, suggesting that an environmental change was of great importance and that probably the anaemia was the result of food refusal.

Mengel, Carter and Horton (1964) quoted the case of a 17-year-old Negro girl who developed severe iron deficiency anaemia and hypokalaemia following clay eating for 2 years. Her dietary intake of food had been normal. The clay was found to adsorb potassium *in vitro* and laboratory studies suggested that clay ingestion could lead to iron deficiency anaemia, probably by such binding of dietary iron rather than by dietary displacement. This mechanism may have been responsible for the deterioration noted among slaves with pica by two much earlier writers: Craigin (1835) and Carpenter (1844-45) discussed the syndrome of cachexia africana, a disorder which would often pursue a downhill

course among slaves on large plantations in the Southern states of the USA. While vitamin deficiencies may have been partly responsible for this condition, there was also an uncontrollable craving to eat unusual materials such as earth. Substances containing iron and potassium were found to be beneficial and it may be that the earth ingested was adsorbing a certain amount of these two elements.

In a study in Turkey of 73 patients with pica and 69 controls, Okcuoglu *et al.* (1966) concluded that anaemia was three times more common in those with pica than in controls; in some the anaemia might have existed before the pica, but this was difficult to prove. Pica was sometimes present in those without anaemia and, in some, pica stopped without iron therapy on admission to hospital even though anaemia was present. A later study in Turkey (Cavdar and Arcasoy, 1972) emphasized the presence of iron deficiency anaemia in Turkish children with long-standing pica for soil and clay. There was marked growth retardation and lag in bone age. It was assumed from *in vivo* experiments that the cations in soil and clay entered into an ion exchange retention reaction with dietary iron, zinc and perhaps other trace metals, resulting in a typical complex of deficiency symptoms. The present state of indecision can be summed up in the words of Okcuoglu *et al.* (1966), 'Coexistence of poor nutrition and pica does not necessarily establish that they are causally related'.

The studies of Gutelius

The most comprehensive assessment of the importance of iron deficiency anaemia as a causal factor in pica in relation to the entire socio-psychological situation has been made by Gutelius *et al.* (1962). She studied 30 Negro children with pica, aged from 2 to 5 years, who were without chronic illness (including lead poisoning, mental retardation or organic brain damage). Her definition of pica was the ingestion of unsuitable materials more frequently than once a week for at least 6 months. The controls were 28 children, carefully selected, who had not ingested such materials after 18 months of age or for at least 18 months prior to the study. Extensive investigations included the medical history, physical examination, anthropometric data, psychometric assessment, laboratory tests, socio-economic data and behavioural observations. The pica children had lower haemoglobins (mean 10.13 g/100 ml; range 6.8–12.6 g/100 ml) than the control group (mean 11.2 g/100 ml; range 9.9–14.0 g/100 ml), but the difference was small although considered significant ($p < 0.01$). In addition, the pica children had lower ascorbic acid levels in the blood, poorer diets, more unmarried mothers, more frequent change of home, more siblings cared for by relatives, less adequate play resources, more homes with peeling plaster and paint, and more families with major emotional problems. They displayed more behaviour problems such as temper tantrums, and persistence of early oral patterns such as insistence on a

pacifier, thumb-sucking and mouthing objects. There was no difference between the two groups in the clinical evaluation of nutritional status or in the number of physical defects.

Gutelius studied the effect of intramuscular iron therapy on 16 of these children with pica. A similar group with pica received saline injections. Haemoglobin level testing and a rating of the severity of the pica were made at intervals. A satisfactory rate of cure was found in both groups and was not correlated to haemoglobin levels. Cases who relapsed tended to come from disturbed families and those who did well from good families.

A further study by Gutelius *et al.* (1963) was a double-blind trial of the treatment of pica with mineral-vitamin tablets and placebo tablets. There were 12 children with pica in each group, all were coloured, and there were many with poor housing and poor standards of child care. After six to seven weeks of taking the tablets, 7 in each group were free from pica or much improved, and at the end of the trial, three to thirteen months after the treatment period, only 3 in each group had shown little or no improvement.

Both these studies by Gutelius emphasized the global deficiencies in the environment of children with pica in which iron deficiency as an aetiological factor may be insignificant and iron therapy may play only a minor part.

In contrast to these general findings, 1 child was described by Gutelius as having the lowest haemoglobin level, the most severe pica in the series, a good family background and an excellent response to iron. This case is more like those described by Lanzkowsky where, in general, the haemoglobin levels were much lower than those in Gutelius' study and the social problems, although not analysed in detail, were probably not as severe as in the majority of families examined by her.

It would appear that the findings of Lanzkowsky and of Gutelius are at variance with regard to the emphasis they place upon the aetiological significance of iron deficiency. However, Gutelius stated that there may be two types of pica: one as described by her where there is strong association with disorganized living, no reduction in weight and not causally associated with iron deficiency; and a second type of pica where there is pre-existing iron deficiency, feeding difficulty, reduction in weight and very little in the way of obvious environmental disorder (reported in Catzel, 1963).

McDonald and Marshall (1964), in an attempt to settle the Gutelius-Lanzkowsky controversy, conducted a study of 25 children with pica (average age at the beginning of the study: 1 year 10 months) in which there were no significant psychological or environmental problems. All the children except one were adequately nourished, and the pica was almost entirely specific for sand. These children were divided into two groups; one group was given iron and the other saline. A significant difference in the cure rate at three months was obtained in favour of iron. The children who were given saline and persisted with pica after six months were all cured when given iron; 4 cases

relapsed and it was found that the haemoglobin had fallen. The mean haemoglobin level in this study (10.4 g/100 ml) was higher than that in Gutelius' series (10.1 g/100 ml). Those who became pica-free had higher haemoglobin levels than those with continuing pica. After five to six months, however, the cure rate showed no difference in the two groups and the haemoglobin levels in the groups also showed no difference, but were significantly lower in those children with pica regardless of whether they had received iron or not. The conclusion was that pica could be cured by iron in nearly all cases, but that permanent cure might be dependent on maintaining adequate haemoglobin levels.

An interesting short case report by Hambridge and Silverman (1973) describes a 2-year-old girl with a zinc deficiency whose specific pica for metal ceased and whose appetite and growth improved with dietary zinc supplementation. Perhaps metals other than iron need closer scrutiny in the future if the cause of pica is to be found in every case. Delves, Bicknell and Clayton (1972) have studied 12 different metals in the blood of controls and children with pica and have thus expanded the horizon of research that has hitherto concentrated on lead and iron metabolism.

PICA AND LEAD POISONING ASSOCIATED WITH SPECIFIC HANDICAPS

It has already been stated that the young child passes through a developmental phase when exploration of the world is mainly through the immediate sensory modalities of touch, smell and oral exploration, these becoming less important as the distant sensory modalities of hearing and vision allow a more sophisticated exploration of the environment. A child with a defect of vision and, occasionally, of hearing may, however, continue to utilize oral exploration. The mouthing of lead type for purposes of identification in one school for partially sighted children of normal intelligence resulted in lead encephalopathy in 1 child and in the discovery of several children in the school with raised blood lead levels (Ames and Swift, 1968).

OTHER SEQUELAE OF PICA

Infestation

While the outstanding complication of pica is lead poisoning, several authors have noted other complications. Shrand (1964) quoted the case of a girl with pica for soil. She had a puppy infected with *toxocara canis* and she developed a similar infestation. Jacobziner (1962) described a Puerto Rican child with ascariasis because of pica. In the study (already quoted) by Lankowsky (1959), 10 out of 12 of the children with pica had intestinal infestation, ascariasis being the most common.

Acute accidental poisoning

Prevalence studies for both accidental poisoning and for pica suggest that the same age groups are affected and that the peak incidence in both conditions occurs at about 1-3 years of age. The prevailing social conditions also appear to be similar. Children with pica are liable to episodes of accidental poisoning, and, conversely, children who are accidentally poisoned frequently have pica. Jacobziner (1966b) found the highest incidence of accidental childhood poisoning to be in the age range of 2-3 years, followed by those 1-2 years old. He ascribed the high risk to the mobility of young children and the desire to explore. He found a higher incidence in non-white children, which he felt was due to social inadequacies and ignorance.

Lourie, Layman and Millican (1963) found that 50 per cent of children hospitalized for accidental poisoning had pica. Craig (1955), in a survey of 31 children with accidental poisoning, found that 40 per cent had pica compared with 8 per cent in a control group of children of the same social class: 78 per cent of the controls had normal oral patterns of behaviour compared with only 24 per cent of the poisoning cases. Whereas finger-sucking and comfort blankets at night were common among the controls, similar patterns of behaviour combined with feeding disorders were seen during the day in the poisoned children. An examination of the family background suggested that distorted oral patterns were part of a widespread psychological disturbance.

In a paper by Jackson, Walker and Wynne (1968) on acute accidental poisoning in childhood, they commented on the wide range of substances taken, from aspirins to fireworks. 'This variety is a tribute to the growing child's desire to learn about his environment at a time when he has not yet outgrown the oral stage of his development and has not yet developed a sense of discrimination in taste.'

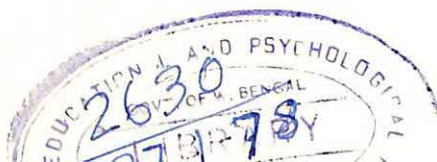
Intestinal obstruction

Intestinal obstruction may occur as a result of ingesting cloth, toys, stems of plants, etc., and has been described in adults as well as children (Gaur, 1967; Bicknell, Clayton and Delves, 1968). In addition, two children were reported with acute antihistamine poisoning where non-edible substances were found in the bowel (Davis and Hunt, 1949; Prain, 1950).

PREVENTION AND TREATMENT OF PICA

Reference has already been made to the various attempts to treat pica by iron therapy and the varying success this has had with workers in different situations. Mention has also been made of the treatment of pica by psychotherapy and by behaviour modification techniques (Woody, 1971). The

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problem of prevention has been approached from the epidemiological and sociological point of view.

Schucka *et al.* (1965) described an attempt in the poorer areas of Baltimore to reduce the incidence of pica and lead poisoning by education of the parents. Because of the cost, stripping the houses and repainting was not feasible. The houses were divided into two groups. In one, the families were visited, parents warned of the dangers of eating paint, leaflets were handed out and paint in the house analysed. Such a programme of education was not found to alter significantly the trends in incidence of lead poisoning and, therefore, one may presume, the habit of pica.

Jacobziner (1966b), however, described a more successful programme devised for poorer parts of New York City, in which there was widespread education of parents and doctors concerning the danger of pica, routine queries for pica at child health clinics, an efficient laboratory service for blood lead estimations and facilities for the treatment of any discovered case. All homes in 'lead belt' areas were visited and urine specimens for coproporphyrins collected from children under 7 years. A public health nurse was involved in providing intensive help and education whenever there was lead intoxication. By using such a system the numbers of reported cases per year increased from 25 to 338 over 10 years but the mortality fell from 50 to 2 per cent as a result of early diagnosis, detection of mildly affected children and effective help.

Publicity in Britain concerning the dangers of pica and the possibility of lead poisoning has been given by the Department of Health and Social Security, the Home Office, the Royal Society for the Prevention of Accidents, the National Home Safety Committee, the British Broadcasting Corporation and the British Safety Council. Unfortunately, families where the danger of lead poisoning exists are not those likely to be influenced by such propaganda (Boucher, 1965).

AVAILABILITY OF LEAD IN THE PRESENT-DAY ENVIRONMENT

From the foregoing review one may conclude that children with pica come to medical attention either because of lead poisoning or some other adverse effect of pica, or as a result of routine questioning, and only a few will be referred to the doctor because of the problem of pica itself.

The incentive to learn more about the aetiology of pica comes from the knowledge that many children are being damaged by lead intoxication and that lead is still available to children with pica in a modern, health-conscious environment such as ours (*Which?*, 1973).

There is evidence to suggest that the over-all contamination of the atmosphere, the soil and water supplies is slowly increasing; for example, leaded fuel for cars means that atmospheric pollution is greatly increased in urban areas. The human body is not designed to cope with this type of

pollution as the excretion rate is slow, the burden of lead in the body building up gradually over the years.

It is important, therefore, that the intake of such a cumulative poison is not accentuated by the exposure of children to unnecessary quantities of lead.

What has been done to eliminate lead from our environment and why is it still used so frequently? Presumably it is the versatility and industrial value of lead that explains why this potentially dangerous metal has retained its popularity down the ages. It is malleable, ductile and resists many forms of chemical attack. It was hoped that this problem of contamination by lead might be brought under control by regulations instituted since the end of the nineteenth century, but these hopes have been only partially realized. The Lead Processes (Medical Examinations) Regulations 1964, require three-monthly blood examinations for lead workers. The Food and Drugs Act 1955 (Lead in Food Regulations 1961) has restricted the amount of lead that may be present in food and drink offered for sale for human consumption, but there is no legal standard to limit the lead content of drinking water supplies despite international recommendations laid down by the World Health Organization several years ago (*The Times*, 1960). Despite these inadequacies, evidence of lead intoxication, either in industry or as a result of contamination of food and drink, is now an unusual occurrence, although reports are made from time to time (Beattie *et al.* 1972a, b). Unfortunately, one cannot say the same about childhood lead poisoning.

Toys were a particular hazard for all too long. In 1961 the British Standards Institution (BS 3443:1961) required that paint used on toys should contain not more than 1.1 per cent of lead. A further recommendation was that plastic toys should contain no more than 250 parts per million (0.025 per cent) of lead. These standards were, of course, not mandatory. In 1964 it was thought by some that this recommendation was not strict enough. The Royal Institute of Public Health and Hygiene had previously suggested a maximum lead content of 0.01 per cent (100 parts per million) for paint on toys and this had been accepted by various toy manufacturers. However, paint containing up to 1.1 per cent of lead was still applied on toys 'unlikely to be sucked' such as tricycles and construction kits (*The Times*, 1964).

Teaching materials, graphite pencils and crayons have also been the subject of scrutiny and the Department of Education and Science sent out a memorandum (2/65) in 1965 to local education authorities recommending a content of not more than 0.025 per cent (250 p.p.m.) of lead and other heavy metals in teaching materials.

In the summer of 1964 attention was focused on the problem of lead in plastic toys imported from Hong Kong. These were found to contain varying amounts of lead up to 0.26 per cent (2,600 p.p.m.). Tests were carried out to see how much of this lead was extractable by the action of hydrochloric acid and by sucking and chewing; these showed that only a minute amount was

likely to be absorbed by the child. The conclusion was, therefore, that these toys did not present a serious health hazard, but as there was no reason why lead should have been present in these plastic materials the Home Office wrote to importers recommending that the lead content of plastic toys should not exceed 0.025 per cent (250 p.p.m.). The Hong Kong Government gave an assurance that their toy manufacturers would comply with this ruling.

The public have a right to know the type of paint they are applying to their house or to toys they are repainting. The Lead Paint (Protection against Poisoning) Regulations 1927 required the containers of paint with a content of more than 5 per cent soluble lead to indicate that the paint contained lead. In 1961 it was agreed by representatives of the Paint Manufacturer's Association of Great Britain, the Association of Lead Manufacturers Ltd. and the Ministry of Health that containers of paint with a lead content of more than 1.0–1.5 per cent of lead should be labelled 'Do not apply on toys, furniture or interior surfaces that might be chewed by children'. It was appreciated that a considerable danger rested with the 'handyman' who ignored the warning label.

Paint for exterior decoration may contain up to 90 per cent total lead; this type of paint can be detected by the absence of a high gloss and by the relative lack of smoothness of the surface.

The chewing of painted window ledges and other accessible spots is often a greater problem than toys, for even with the use of 'lead-free' paint, old repainted surfaces are likely to contain lead which may reach a high concentration under the new layer of paint (Barltrop, 1968). *Figure 13* (page 133) illustrates that several layers of paint may be uncovered by chewing. In addition, the lead in the original primer may have soaked into the wood. A lead-free primer for wood has been produced and is technically satisfactory (Memorandum, Hadfield's Paint Factory, 1961–1962).

METHODS OF ASSESSING DEGREE OF LEAD INTOXICATION IN A CHILD

Many tests are used in industry for the diagnosis of lead poisoning and for the control of lead absorption. The punctate basophil count, haemoglobin level, blood and urinary lead levels, urinary coproporphyrins and urinary delta-aminolaevulinic acid concentration have all been recommended and are still used. An objective study of their relative merits in assessing industrial exposure to lead was carried out by Williams, King and Walford (1968), and the blood lead estimation was found to have the greatest value. The same estimation is thought to be the most useful in the assessment of lead intoxication in children (Moncrieff *et al.*, 1964).

Urinary lead levels may be helpful, especially where blood is difficult to obtain or repeated venepunctures are unduly distressing to the child. However, 24-hour urine collections from a child are virtually impossible to obtain with

any degree of accuracy, and the need to estimate lead levels in random specimens of urine introduces yet another variable, the concentration of the urine, but 80 $\mu\text{g/l}$ is accepted by several workers as the upper limit of normal for children (Kehoe, 1964; Griggs *et al.*, 1964; Cohen, Lourie and Abernethy, 1965; Berman, 1966).

The concentration of lead in the blood that is considered to be the upper limit of normal varies with the laboratory and the worker. Whereas levels of 40–60 $\mu\text{g}/100\text{ ml}$ are accepted by some as the upper limit of normal, Moncrieff *et al.* (1964) suggested that 36 $\mu\text{g}/100\text{ ml}$ should be taken as the maximum acceptable for children. From their experience in Birmingham, Betts, Astley and Raine (1973) agree with this figure. In the *British Medical Journal* (1968) a statement on the diagnosis of lead poisoning accepts as normal blood lead levels of less than 40 $\mu\text{g}/100\text{ ml}$ and urinary lead levels of less than 80 $\mu\text{g/l}$. Goldwater and Hoover (1967) published the results of a worldwide study on blood and urinary lead levels in normal adults and found levels lower than these: 35 $\mu\text{g/l}$ was the mean for lead concentration in urine; the mean value for blood lead levels was 17 $\mu\text{g}/100\text{ ml}$. There was surprisingly little difference between the levels found in urban and rural communities and in developing and industrial countries.

The blood lead level is an indication of the balance between absorption of lead by the lungs or gastrointestinal tract, excretion by the kidneys and the rate of deposition in bones and other organs. Hence, of itself, it cannot represent the total body load of lead. A radiograph of the growing ends of long bones is helpful in the assessment of the body store of lead, lead deposition leading to a modelling failure and lines of increased density at the metaphyseal line. Sudden pyrexial illness in a child with a large store of lead in the bones may result in a rapid rise in blood lead level, and encephalopathy may develop. Hence, a moderately raised blood lead level and radiographic evidence of lead deposition in bones indicate a dangerous situation requiring therapy.

The increase in urinary excretion of lead following the exhibition of one of the chelating agents may be measured as a further estimate of the body load of lead. Various tests using calcium EDTA or penicillamine have been devised (American Academy of Pediatrics, 1961; Whitaker, Austin and Nelson, 1962; Cohen, Lourie and Abernethy, 1965; Gibson *et al.* 1967).

The lead concentration in head hair of children has been measured and the results suggest that this may be a good method of assessing time and duration of exposure to lead (Kopito, Byers and Schwachman, 1967; Pueschel, Kopito and Schwachman, 1972).

3

Methods

SELECTION OF CASES

The aim throughout this study was to select children who had pica, or who were thought to be at risk of developing this symptom, and to identify the various aetiological factors that were or may have been important. Groups from highly selected populations were used for the first two parts of the study and the difficulties in interpreting results from such a biased sample have not been overlooked.

Several possible criticisms must be examined concerning the selection of the 15 children with pica, for the third part of the study. Firstly, the group is small, but this was deliberate to enable an in-depth study to be undertaken. Secondly, it may be supposed that there was a tendency to refer children with psychological difficulties as the author bears the label of 'psychiatrist'. However, working in a comprehensive children's hospital for the greater part of the study, the author was known for her interest in child health in all its aspects rather than their psychological problems alone. Thirdly, these 15 children represented consecutive referrals of children with severe pica and so there was no sample bias created by the author. The wide range of referral agencies and the varying areas of south London and the suburbs in which the children lived suggest that a comprehensive cross-section of the surrounding population was represented.

CONTROL GROUPS

Control groups were used to study particular aspects of the children with pica, but were not used in every part of the study.

In the first part, two control groups were used within the same hospital population, involving children with no pica but subjected to a similar environment and standards of care. In the second part, no controls were used

in the study of socially deprived children since it was considered sufficient to compare the results of blood lead levels with the accepted norms for childhood. The inclusion of one control group for part three, the longitudinal study of 15 children with pica, was considered but finally it was decided that comparisons of the following types would be more useful.

(1) Comparison within the group of subjects with pica (e.g. intelligence, duration of pica, quality of maternal care).

(2) Comparison of longitudinal data for each child as an individual (e.g. appetite disturbances, behavioural patterns).

(3) Comparison with siblings (e.g. illnesses and accidents, sleeping difficulties).

(4) Comparison with accepted norms for childhood population (e.g. birth weights, heights and weights, blood lead levels).

(5) Comparison with epidemiological surveys of the same sociological environment (e.g. social class).

(6) Comparison with a population of children of the same age group living in the same sociological environment (e.g. personality profile).

LABORATORY METHODS

The methods used in this study for the assessment of blood and urinary lead concentrations are described below.

Method of collection of blood specimens

A disposable plastic syringe was rinsed with sterile lithium heparin solution 1,000 units/ml, the skin carefully cleaned and the blood taken by venepuncture; the heparin was tested for lead contamination and found to be free. The blood was mixed well to prevent clotting, left in the syringe with the needle bent back and taken to the laboratory for analysis.

The syringe containing blood was placed in the freezer compartment of a refrigerator for at least 30 minutes, depending on the temperature setting.* After complete freezing the sample was allowed to thaw at room temperature and was then stored at between 0 and 5°C until required for analysis.

Determinations were carried out in duplicate on 0.5 ml of haemolysed blood.

* About 90–95 per cent of the lead present in blood is bound to the red cells and it is important to analyse whole blood rather than plasma. Even vigorous shaking of a blood specimen is insufficient to render it homogeneous long enough for truly representative samples to be taken. If the specimen is haemolysed the intracellular fluid can mix freely with the plasma and shaking will produce a homogenous solution. Of the various methods of haemolysis, freezing and thawing is to be preferred because this is accomplished without removing the specimen from the syringe and without adding any reagents, thus precluding any risk of contamination.

Method of collection of urine specimens

Urine samples were passed into a plastic pot that had previously been carefully washed. The specimen was then transferred to a 100 ml Polythene bottle, cleaned by washing with 10 per cent v/v lead-free nitric acid solution and deionized water. The preservative used was 2 ml of 50 per cent v/v lead-free nitric acid solution. These specimens were stored at between 0 and 5°C until required for analysis.

Determinations were carried out in duplicate on 5.0 ml urine.

Determination of lead concentration

Principle

Blood and urine specimens were digested with an acid mixture and evaporated to dryness, care being taken to avoid contamination. The residues were dissolved in a nitric acid-ammonium citrate solution. The concentration of lead was then determined colorimetrically with dithizone using a Technicon autoanalyser.

Materials and apparatus

The reagents were prepared and the glassware washed with deionized water obtained by passing the water from a commercial deionizing kit through a column of mixed-bed ion exchange resin. Pyrex glassware was used throughout and new glassware was pre-treated with boiling nitric acid.

Reagents

The following reagents were the 'low in lead for foodstuffs grade' containing 0.005 p.p.m. lead; nitric acid, SG 1.42; perchloric acid, SG 1.54; sulphuric acid, SG 1.84; ammonia, SG 0.88; and potassium cyanide.

Other reagents required were citric acid, low-in-lead (0.5 p.p.m.) sodium sulphate, Analar grade; chloroform (May and Baker, R. grade); dithizone (Kodak, Chemical Division, Kirby, Liverpool).

For the analysis of lead solutions it was necessary to shield the dithizone reservoir bottle and the extractor coil from light. Dithizone solutions were prepared fresh on the day of use.

Working standard lead solutions

A lead solution of concentration 10 µg/ml was made by diluting a stock standard lead solution (1 mg lead/ml) with acid ammonium citrate solution. From this, lead solutions containing 0.05–0.30 µg lead/ml were made using the same diluent. This range corresponded to 25–150 µg lead/100 ml blood.

Standard solutions containing 25, 50, 75, 100, 125, 150 µg lead/100 ml blood were used in each assay to give the calibration equivalents.

Results (see Figures 1 and 2)

A calibration curve of peak height and lead concentration of the working standard lead solutions was made and used to determine the concentrations of lead in the blood digest solutions. The mean of the two results for each blood specimen was taken as the estimated lead concentration and acceptable agreement was found provided the specimen had been thoroughly haemolysed. From this mean result was subtracted the concentration of lead found in the 'blank' estimation, which consisted of all the reagents used but no blood specimen.

For the concentration range 25–150 μg lead/100 ml the calibration curve was found to be almost linear. If the lead concentration of the blood digest solution was above 200 μg /100 ml, the sensitivity of the analyser was halved and accurate results still obtained, an additional strong standard solution being added at the end of the batch of specimens (Delves and Vinter, 1966). The lower limit for accurate quantitative detection was approximately 5 μg lead/100 ml blood.

Estimation of lead concentration in samples of wood scrapings, earth, etc.

If the concentration of lead was greater than 0.5 mg/100 g of the sample, the estimation was more accurately performed on the Atomic Absorption Spectrophotometer. In this apparatus a hollow cathode lamp produces radiation that is characteristic of the metal from which the cathode is formed. For lead estimations a lead cathode was used and the specimen thought to contain lead was ashed, dissolved in hydrochloric acid and sprayed in the flame. Any lead present formed atomic vapour which absorbed radiation at the characteristic wavelength produced by the lead cathode lamp. The reduction in the intensity of light emitted from the cathode lamp after traversing the flame was proportional to the concentration of lead in the specimen. A photoelectric cell measured this reduction in light intensity, which was compared with the decrease in light intensity produced when water was sprayed into the flame; the difference was proportional to the amount of lead in the specimen. By using known standards a calibration curve was obtained and absolute lead concentrations calculated. The use of a specific cathode for lead ensured that only that particular metal was measured.

Unfortunately, this method was not sufficiently sensitive to measure accurately the small amounts of lead that were frequently found in blood and urine.

Lead concentrations in wood, paint, putty, etc., were expressed as a percentage by weight (lead soluble in hydrochloric acid) or, for lower concentration, as parts per million by weight (lead soluble in hydrochloric acid).

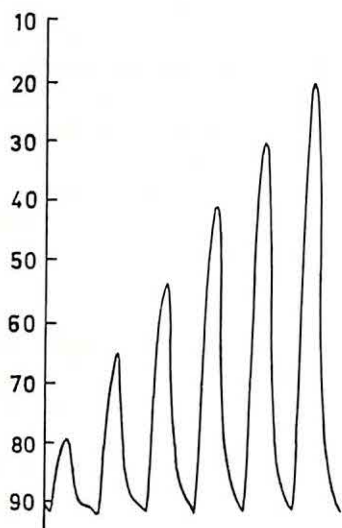


Figure 1. Technicon autoanalyser: results I. The peaks are obtained when working standard lead solutions in acid ammonium citrate solution are passed through the analyser. These peaks produce an almost straight calibration curve

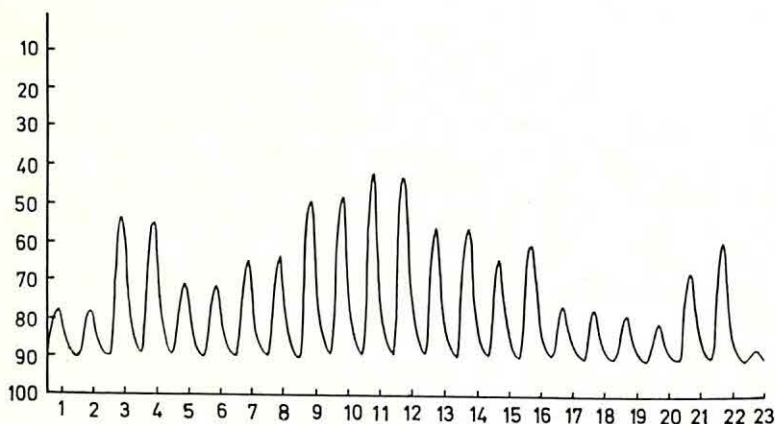


Figure 2. Technicon autoanalyser: results II. These peaks represent specimens of blood passing through the analyser in duplicate. There is a small but acceptable difference between the two peaks of each duplicated specimen. (The peak at the far right of the illustration is from a 'blank' determination)

4

Pica in the Severely Subnormal Child

Three groups out of a population of 330 hospitalized severely subnormal children in long-term care were selected according to the severity of pica and degree of physical handicap. The aims of this part of the survey were fivefold:

- (1) To examine the causes of the severe subnormality in the three groups in an attempt to assess the possible aetiological role of primary lead poisoning;
- (2) to define more clearly the type of child with pica in such a hospital population;
- (3) to examine blood lead levels;
- (4) to assess the value of an oral calcium EDTA-lead excretion test, as an index of the total body load of lead;
- (5) to examine the frequency of pica among this and similar populations.

METHOD

Selection of subjects (Table 1)

Senior ward staff were asked to group the children in their care into one of three categories:

- (1) 'scavenges so frequently that the child is a problem in management';
- (2) 'never or almost never scavenges';
- (3) 'occasionally scavenges'.

Two independent assessments were made for each child. For this study all children in category (1) were included in the 'pica' group; and the 'no pica' and physically handicapped groups were selected from those in category (2). The children in category (3) were not investigated further.

Table 1
Composition of the Three Groups

	<i>Pica</i>	<i>No Pica</i>	<i>PH</i>
Number of children	27	12	14
Mean chronological age (years)	9.0	12.7	10.3
Mean mental age (months)	15.6	28	7.1
Mean length of hospital stay (years)	5.3	6.2	5.5
<i>Additional handicaps</i>			
Blindness	2	1	4
Cerebral palsy	4	0	12
Epilepsy	11	2	10
Behaviour problem (serious)	10	2	2
<i>Cause of subnormality</i>			
Perinatal difficulties	5	2	3
Specific diagnosis (including Down's syndrome)	10	6	6
Known cases of primary lead poisoning	1	0	0
Possible cases of primary lead poisoning	1	0	0
Not known	12	6	5

PH: physically handicapped

'Pica' group

Twenty-seven children were rated by both assessors to be in category (1). These children had a mean chronological age of 9.0 years (range 2.6–16.3 years) and a mean mental age of 15.6 months (range 6.0 months–2.5 years). Four were assessed on the Stanford–Binet Intelligence Scale (Form L-M), and 23 were assessed on Piaget sensorimotor scale of development (Woodward, 1959). The mean length of hospital stay was 5.3 years.

Fifteen had additional serious handicaps; of these, 2 were blind, 4 had cerebral palsy and 11 had epilepsy. Ten had a severe behaviour disturbance; of these, 3 were over-active, 2 withdrawn, 1 psychotic and 6 unduly aggressive; one problem in particular was biting other children.

Pica in 19 seemed completely indiscriminate, in 2 it showed some selection for paper and clothes and in 6 it was predominantly for one type of substance; there were 3 for painted wood, 1 for fluids of all kinds (diabetes insipidus had been excluded), 1 for paper and 1 for putty.

The cause of the subnormality was not known in 12 cases; perinatal difficulties sufficient to cause brain damage had occurred in 5 and a diagnosis

had been made in another 10, including 1 case in which lead poisoning was definitely a causal factor (Berg and Zappella, 1964). Of the 12 subjects in which a specific diagnosis had not been made, mental retardation had been diagnosed in 9 before the age of 12 months and prior to the onset of walking or standing, which makes lead poisoning an unlikely cause of primary brain damage. In 1 child the delay in walking raised the question of mental retardation which was subsequently confirmed, and in 2 children mental retardation became apparent after walking had been achieved. In 1 of the latter lead encephalopathy was excluded following detailed investigation at the time. In the other case no investigations had been carried out at the time and therefore lead poisoning cannot be excluded for certain although the history was not suggestive. Despite the deficiencies of retrospective data one may conclude that in only 1 out of the 27 children with pica can lead encephalopathy be considered as an established primary cause, and in 1 a possible primary cause of the mental retardation.

'No pica' group

For the purpose of a control group, 12 severely subnormal children were selected who were classified in category (2) 'never or almost never scavenges'. All these children were fully ambulant, took a normal diet, and all but 1 attended the hospital school for severely subnormal children. They were selected from among the least handicapped of the hospital population and represent the nearest possible approximation to a control group of normal children but experiencing the same basic environment as the children with pica. These 12 children had a mean chronological age of 12.7 years (range 7.2-14.2 years) and a mean mental age of 2.3 years (range 1.5-3.5 years). Nine were assessed on the Stanford-Binet Intelligence Scale (Form L-M), and the other 3 assessed on the Piaget sensorimotor scale of development. The mean length of stay in hospital was 6.2 years.

One child was blind, 2 had psychotic features and 2 had epilepsy; none had cerebral palsy. The cause of the subnormality was not known for certain in 6 cases. Lead poisoning had not been implicated in any of these children, and a reappraisal of the data would suggest that it was most unlikely. In 2 there were perinatal difficulties, 3 had Down's syndrome, 2 were brothers with Hurler's syndrome and 1 was a premature twin.

Physically handicapped group

Fourteen children were selected who were severely physically handicapped, unable to walk or to feed themselves and were classified by both senior members of the ward nursing staff as in category (2), 'never or almost never scavenges', most being unable to put hand to mouth. However, none was severely debilitated nor prone to frequent severe respiratory tract infection. None of these children attended the hospital school. Their mean chronological

age was 10.3 years (range 5.3–13.0 years), and their mean mental age 7.1 months (range 1.5–24.0 months). All were assessed on the Piaget sensorimotor scale of development. The mean length of stay in hospital was 5.5 years.

Twelve of these children had cerebral palsy, 4 were blind or partially sighted and 10 had epilepsy. Two showed disturbed behaviour such as screaming or self-mutilation on occasions.

The cause of the subnormality was known in 9 subjects, in 3 of whom perinatal brain damage had occurred. In 5 the cause of their handicap was unknown despite full investigation.

Oral calcium EDTA-lead excretion test

The following test was carried out to compare the degree of lead ingestion in the three groups of children.

Day 1	Monday	Blood specimen for lead. One single random specimen of urine	Oral calcium EDTA 250 mg b.d. for 3 days
Day 2	Tuesday	Random urine	
*Day 3	Wednesday	Random urine	
Day 4	Thursday	Random urine	
Day 5	Friday	Random urine	
*Day 6	Saturday	Random urine	
Day 7	Sunday	No specimens needed	
Day 8	Monday	Blood and random urine specimens	

*These specimens proved unnecessary in the final test design; see 'Results' section.

RESULTS

The blood lead levels for the three groups before and after administration of oral calcium EDTA (day 1 and day 8 respectively) are shown in *Figure 3*.

There was no significant difference in these levels for any group before and after the administration of calcium EDTA ($p > 0.5$ for all three groups), but the difference in the blood lead levels between the 'pica' group and the other two groups was highly significant ($p > 0.001$ in each case). There was also a significant difference ($p > 0.05$) between the blood lead levels on day 1 of the physically handicapped group, and the 'no pica' group. Eighteen children (67 per cent) in the 'pica' group, 1 child (8 per cent) of the 'no pica' group and no physically handicapped children had blood lead levels greater than 36 $\mu\text{g}/100\text{ ml}$.

An analysis of blood lead levels where the pica was selective or fairly selective, revealed that those chewing paper and clothes and drinking fluids had, as expected, lower blood lead levels (4 children with a mean blood lead level of 33 $\mu\text{g}/100\text{ ml}$; range 22–50 $\mu\text{g}/100\text{ ml}$) than those chewing painted wood and putty (4 children with a mean blood lead level of 66 $\mu\text{g}/100\text{ ml}$; range 39–88 $\mu\text{g}/100\text{ ml}$).

The mean urinary lead levels for day 1 to day 8 in response to oral calcium EDTA are shown for each group in *Figure 4*.

The mean urinary lead levels for the 'pica' group were significantly greater ($p < 0.025$) than those for the other two groups for each day of the investigation. The increase in the urine lead levels was greater in response to calcium EDTA for the 'pica' group than for the other two groups.

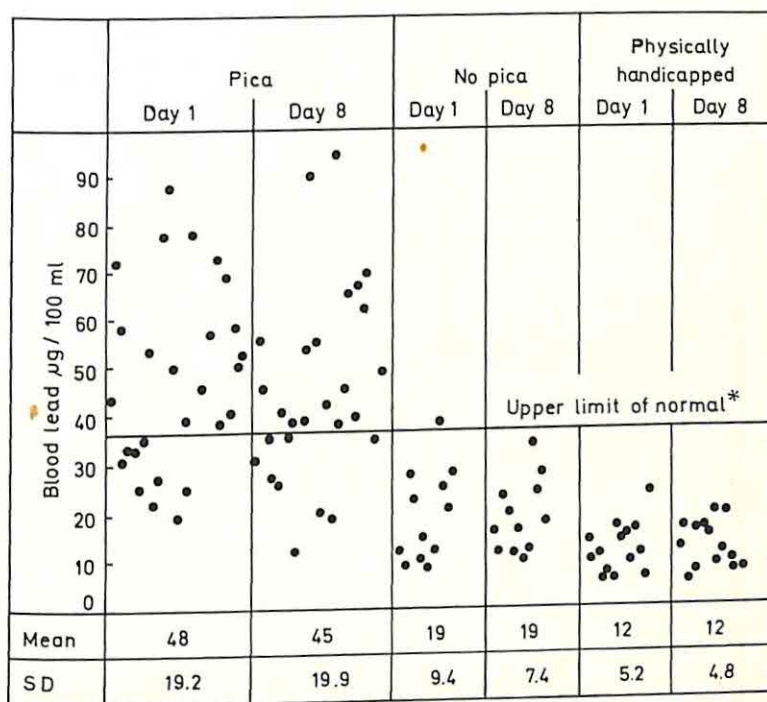


Figure 3. Blood levels on day 1 and day 8 of the oral calcium EDTA test for the three groups. (Reproduced from Bicknell, Clayton and Delves, 1968, by courtesy of the Editor)

* Moncrieff *et al.*, 1964

In order to minimize errors due to the use of random specimens of urine and the possible variation in urine lead levels throughout the day, the baseline levels (the mean of days 1 and 2) and calcium EDTA response levels (the mean of days 4 and 5) were calculated for each child. The results of the urine collection on day 3 were omitted from these calculations since the urine may have been collected before or after the administration of the first tablet of calcium EDTA.

Figure 5 shows the mean values of the urine lead levels for the two baseline days and two calcium EDTA response days for the three groups. It can be seen from *Figure 5* that 16 children (59 per cent) of the 'pica' group but no children

from either of the two other groups had baseline urine lead levels in excess of $80 \mu\text{g/l}$, the upper limit of normal for children.

There was no significant difference between the baseline urine lead levels for the 'no pica' group and the physically handicapped group ($p > 0.5$), but the difference between the baseline urine lead levels of the children in the 'pica' group and of those in the other two groups was highly significant ($p < 0.001$).

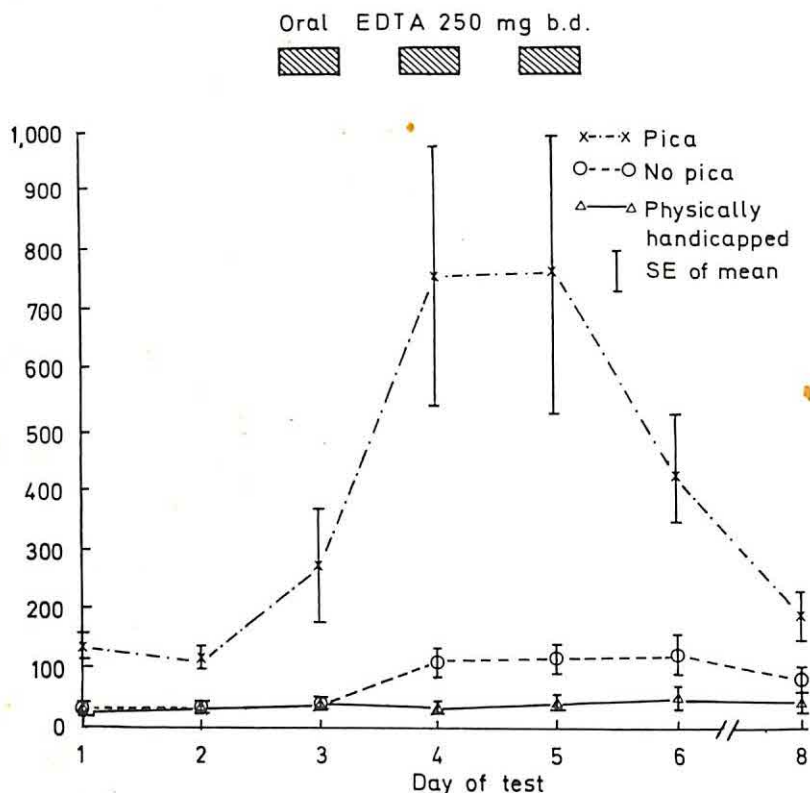


Figure 4. The mean urinary lead levels in response to calcium EDTA for the three groups. (Reproduced from Bicknell, Clayton and Delves, 1968, by courtesy of the Editor)

There were 16 children (59 per cent) from the 'pica' group, but none from the other two groups, with mean urine lead levels in excess of $250 \mu\text{g/l}$ (the proposed upper limit for this test) in response to oral calcium EDTA. There was a considerably greater increase in the mean urine lead levels in response to calcium EDTA for the 'pica' group compared with the 'no pica' and physically handicapped groups ($p < 0.001$ in each case).

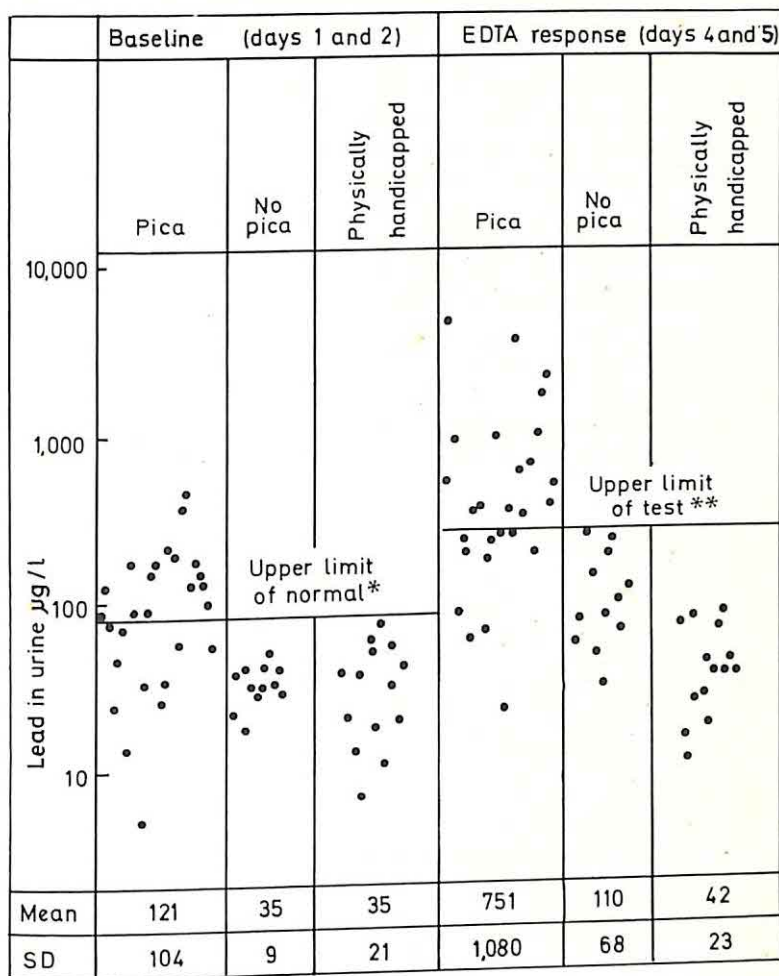


Figure 5. Urinary lead excretion for the three groups during the baseline period (mean of days 1 and 2) and in response to calcium EDTA (mean of days 4 and 5). (Reproduced from Bicknell, Clayton and Delves, 1968, by courtesy of the Editor)

* 80 µg/l: Kehoe, 1964; Griggs *et al.*, 1964; Cohen, Lourie and Abernethy, 1965; Berman, 1966

** 250 µg/l: the mean +2 SD for the 'no pica' group is 246 µg/l

The blood lead levels, baseline urine lead levels and the levels reached in response to calcium EDTA were then compared (Table 2).

Nineteen children (18 in the 'pica' group and 1 in the 'no pica' group) had raised blood lead levels on day 1 of the test. Of these, 14 (65 per cent) had raised baseline urine lead levels, and 16 (75 per cent) an abnormally high response to calcium EDTA. All these children were in the 'pica' group. Only 2 (6 per cent) of the remaining 33 children had a raised baseline urine lead level. Both of these children were in the 'pica' group and 1, in addition to having an equivocal blood lead of 35 $\mu\text{g}/100\text{ ml}$, had an abnormally high response to calcium EDTA. No other child with a normal blood lead level showed an abnormal response to calcium EDTA.

Table 2
The Number of Children in Each Group Showing an Abnormal Result
in the Oral Calcium EDTA-Lead Excretion Test

<i>Group</i>	<i>Pica</i>	<i>Number with pica</i>	<i>PH</i>
Total number of children in each group	27	12	14
Blood lead level above 36 $\mu\text{g}/100\text{ ml}$, day 1	18	1	0
Baseline urine lead level (mean of days 1 and 2) above 80 $\mu\text{g}/\text{l}$	16	0	0
Urine lead levels in response to oral calcium EDTA (mean of days 4 and 5) above 250 $\mu\text{g}/\text{l}$	16	0	0
Number of children with at least two abnormal results	19	0	0

PH: physically handicapped

Table 3
The Incidence of Pica in the Severely Subnormal

	<i>Total number</i>	<i>Number with pica</i>	<i>Incidence (%)</i>
In hospital (long-term care)	330	24	7.3
In hospital (short-term care)	97	3	3.0
Attending junior special school	64	2	3.1

The frequency of pica in this hospital population (long-term care) was compared with the frequency of pica among severely subnormal children admitted (mainly for social reasons) for short-term care, and those attending a junior training school, while living at home. Children in this last group had not been admitted to hospital during the previous two years. Table 3 indicates that pica was more than twice as common among hospitalized severely subnormal children than among the other two groups.

DISCUSSION

An examination of the clinical records of each hospitalized child in this study has shown that in 1 lead poisoning was the primary cause of mental retardation and in only 1 other was it a possibility (see page 33). Both of these children were in the 'pica' group.

This part of the study, therefore, offers no evidence that the presence of pica and possibly raised blood lead levels in established mental retardation are related to the primary cause of the cerebral abnormality, apart from the exceptional case.

The children with pica were more alike in their motility, pattern of intellectual development and behaviour disturbance at the time of the study than in their past history. All but 1 were ambulant despite low mental ages and all had additional handicaps or behaviour problems so serious that they were often restrained for much of the day for their own safety or the safety of others. A comparison of the 'pica' and 'no pica' groups (see Table 1) shows that, while the mean length of hospital stay was approximately the same, the children of the 'pica' group were on average younger, and the mean mental age of this group was almost 50 per cent lower than that of the 'no pica' group. There was also a much higher incidence of epilepsy (40 per cent) and serious behaviour disturbances (40 per cent) in the 'pica' group, compared with the 'no pica' group (17 per cent for each). These data would suggest that pica is frequently seen as part of a behaviour disturbance and is associated with a low mental age at which mouthing and biting objects is an expected developmental phenomenon.

Mouthing and swallowing of inedible objects has often been regarded as purely a function of mental age and, therefore, usually indiscriminate. However, in 6 of the 'pica' group (22 per cent) it was selective and nursing staff supported the view that it was highly motivated. The mean mental age of the 8 children with selective and partially selective pica was 15.0 months, which was the same for the group as a whole. In addition, there was no preponderance of behaviour problems or additional handicaps in these 8 children compared with those whose pica was non-selective. There is therefore no evidence from this study that pica is selective in the more disturbed child, but the numbers are small and the population is a biased sample.

In the daily care of these children the dangers of pica other than lead poisoning have to be remembered; despite the vigilance of nursing staff one child developed reversible intestinal obstruction following the ingestion of balloons, and another caused anxiety by swallowing parts of three thermometers. Both these children displayed considerable guile in obtaining such objects to chew and their experiential world was necessarily restricted because of the supervision they required; the children with pica were regarded as some of the most demanding of nursing and teaching skill because of the behavioural problems involved.

Evidence of excessive lead ingestion in almost 70 per cent in the 'pica' group indicates that the clinician can accurately define a group of mentally retarded children at risk of lead intoxication by observation of their behaviour.

The oral calcium EDTA-lead excretion test, as used in this survey, was designed to be applicable to a busy ward for retarded children where many are doubly incontinent. While the urinary lead concentration is most meaningful on a 24-hour specimen of urine, this is difficult to obtain from the normal child and impossible for practical purposes with the subnormal child. The results of this study have shown that it is sufficient to collect random urines on days 1, 2, 4 and 5 only. Intramuscular calcium EDTA has been used by other workers (Whitaker, Austin and Nelson, 1962); however, it is painful and cannot be recommended if a suitable alternative test with an oral chelating agent is available.

In the present study the group of physically handicapped children was included in order to see the variation in the results of the oral calcium EDTA-lead excretion test with prolonged immobilization, probable osteoporosis of unused bones and a minimal intake of lead due to inability to explore their world or transfer anything to their mouths. As expected, the blood lead levels were lower than in the other two groups and there was no significant response to calcium EDTA. In addition to a minimal intake of lead, it is possible that there is malabsorption of lead in the bowel in such children and that lead may not be deposited in osteoporotic bones or may not be mobilized as readily by calcium EDTA.

From the data presented, the group of children with pica was distinguished from the other two groups by a greater incidence of raised blood lead levels, raised baseline urine lead levels in single random specimens of urine, and by a raised excretion of urinary lead in response to oral calcium EDTA. No undesirable side-effects were associated with the administration of oral calcium EDTA in the dosage used in this test. However, this does not imply that calcium EDTA in therapeutic dosage may be given by mouth with impunity.

It would appear, therefore, that the oral calcium EDTA-lead excretion test may be an additional guide to the degree of lead load in the body.

It is suggested from this study that excessive lead ingestion may be diagnosed when a child exhibits two of the three following features:

- (1) A blood lead level greater than 36 $\mu\text{g}/100\text{ ml}$.
- (2) A baseline urine lead level greater than 80 $\mu\text{g}/\text{l}$.
- (3) A urine lead level in response to an oral calcium EDTA test as described greater than 250 $\mu\text{g}/\text{l}$.

The higher incidence of pica among hospitalized children compared with children having approximately the same degree of handicap but living at home for most of the time may be partly explained by selection procedures for hospital admission. It is well known that, with the shortage of beds for severely subnormal children, those who are admitted represent the most handicapped, the most disturbed and the most disruptive of home life. If, therefore, pica is considered to be an expression of psychological disturbance seen particularly at this young mental age, it is not surprising that the incidence is higher among the hospitalized children. A second explanation relates to the relative lack of recognition of individual needs in the over-crowded and under-staffed ward situation, and pica may be used initially as an attention-seeking device. It is pathetic that the usual means of handling this symptom is by restriction and stifling the emergent personality.

CONCLUSION

There was no evidence that moderately raised blood lead levels had any relation to the original cause of mental retardation.

Pica appears to be more common in the disturbed retarded child and may be both selective and highly motivated even with a low mental age.

The oral calcium EDTA-lead excretion test with random specimens of urine appears to be safe and free from unpleasant side-effects. It may be a useful supplement to blood and urine lead levels when equivocal results have previously been obtained.

Excessive ingestion of lead by approximately 70 per cent of subjects in the 'pica' group was shown from a study of blood lead levels and the urinary lead excretion in response to oral calcium EDTA.

Pica is seen more frequently in hospitalized severely subnormal children and this may be due to the greater degree of handicap or adverse experiences before and/or after admission to hospital.

5

Pica in the Socially Deprived Child

INTRODUCTION

It has been shown in Chapter 4 that severe pica is more common in the mentally retarded in hospital than in the mentally retarded living at home, entering hospital possibly for a few weeks each year. It may be partly that the hospital population is a highly selected one, but in addition there may be an element of under-stimulation inherent in the lack of 'one-to-one' relationships in the hospital population, and not experienced by those more fortunate handicapped children who live at home.

In an effort to examine this aspect of under-stimulation and also the effect of poverty and family disorganization, a survey of the incidence of pica and raised blood lead levels was carried out among the families residing at Frimhurst Recuperative Home—a unit where socially inadequate families are sent for a period of rehabilitation.

Frimhurst Recuperative Home is a large house, part of which is 300 years old, other parts being added later. Up to nine families, who have between them, on average, 20 children, are housed there for periods of 6–12 months while efforts are made to improve their self-respect, standard of living and knowledge of child care by group interaction. No formal teaching or supervision is given and only the extremes of maltreatment of the children are prevented.

Play groups were organized for pre-school and school age children but attendance was not compulsory. Children of school age attended the local village school. Despite the social inadequacies of these families, they were only selected if one or both parents had shown a desire to keep their family together, hence overt rejection of children was most uncommon. All these families came from inadequate, old and often squalid accommodation. Many had lived in derelict houses and some had no fixed abode. For this reason the plan to take

paint scrapings from previous accommodation, should a high blood lead level be found, proved unworkable.

On arrival at the home the standard of maternal care was poor and usually marred by personality defects of the parents and marital disharmony. The children had little supervision apart from that delegated to reluctant older siblings and were therefore usually left to fend for themselves. Minor accidents and illnesses were frequent. The families studied were known to the author, who visited the unit in a consultative capacity.

METHOD

This home was visited regularly over a period of 3 months, and blood samples taken from 29 children, who were all physically well. Only 1 child, a baby of 5 weeks, was excluded from the survey. Each mother was interviewed and the length of stay at Frimhurst was recorded together with the ages of her children and a history of pica if relevant. It was anticipated that the histories obtained may have been inaccurate because of the parents' own problems and the large size of the families. The blood lead levels were seen, therefore, as supporting but not complete evidence for the presence or absence of pica.

RESULTS

The survey showed that 14 children occasionally chewed inedible objects but in none was this severe or persistent. These 14 children were between the ages of 18 months and 6 years. No raised blood lead levels were found. The details of the children involved in this survey and their blood lead levels are set out in Table 4.

Table 4

<i>Age</i>		<i>Blood lead level</i> ($\mu\text{g}/100\text{ ml}$)	<i>Time spent at Frimhurst</i> <i>when blood sample taken</i>
<i>Family 1</i>			
(a)	3 years	33	6 months
(b)	21 months	34	
<i>Family 2</i>	7 years	17	7 months
<i>Family 3</i>			
(a)	6 years	15	6 months
(b)	4 years	20	
(c)	20 months	21	
<i>Family 4</i>			
(a)	4 years	26	3 months
(b)	3 years	20	
(c)	2 years	24	

cont.

Table 4, *cont.*

	<i>Age</i>	<i>Blood lead level ($\mu\text{g}/100\text{ ml}$)</i>	<i>Time spent at Frimhurst when blood sample taken</i>
<i>Family 5</i>			
(a)	6 years	28	3 months
(b)	5 years	24	
(c)	4 years	14	
(d)	3 years	22	
(e)	13 months	14	
<i>Family 6</i>			
(a)	9 years	18	3 months
(b)	7 years	21	
(c)	4 years	11	
<i>Family 7</i>			
(a)	4 years	26	2 months
(b)	5 years	28	
<i>Family 8</i>			
	18 months	10	2 months
<i>Family 9</i>			
(a)	7 years	22	9 months
(b)	6 years	21	
(c)	5 years	20	
(d)	4 years	30	
(e)	$1\frac{1}{2}$ years	34	
<i>Family 10</i>			
(a)	$5\frac{3}{4}$ years	20	1 month
(b)	$4\frac{1}{2}$ years	19	
(c)	7 years	23	
(d)	$4\frac{1}{2}$ years	22	

Scrapings were taken from any object that was at the appropriate height for chewing. It was found that there were many layers of paint on doors and window-sills and no attempt had been made in the past to burn off paint before applying the next layer. The results obtained are set out in Table 5.

Table 5

<i>Source</i>	<i>Quantity of lead (g lead/100 g)</i>
Nursery doorstep	0.16
French window step in the nursery	0.05
Nursery window-sill	0.54
Nursery wall	0.22
Nursery cupboard	0.35
Nursery high chair	0.20
Window frame	0.24

cont.

Table 5, *cont.*

<i>Source</i>	<i>Quantity of lead (g lead/100 g)</i>
Outside window-sill	0.26
Outside drain-pipe	0.25
Dolls house	Insignificant
Child's cot I	Insignificant
Child's cot II	Insignificant
Dining-room chair	Insignificant
Dining-room door	Insignificant
Dining-room table	Insignificant

DISCUSSION

None of the fifteen samples of paint, taken from objects and fittings at a child chewing level, contained appreciable quantities of lead even though the house was old and repainted over previous layers of paint. This result was unexpected and was partly responsible for the absence of raised blood lead levels, another factor being the universal absence of severe pica among these children. The third factor of importance was the length of time spent in the unit. Five out of ten families had been in the unit for 3 months or less, and one might have expected raised blood lead levels in the children of families who had recently come to the unit if they had ingested lead in their previous accommodation. However, there was no supportive evidence that this had occurred.

While there was no doubt that poverty and disorganization abounded in these families and the children were often unsupervised and unstimulated by their parents, no child showed evidence of serious emotional disturbance and none was overtly rejected, the parents managing as well as possible to meet their physical and emotional needs.

CONCLUSION

The data from this brief study suggest that poverty and social disorganization *per se* usually create insufficient psychodynamic stress to predispose the child to such maladaptive feeding patterns as pica.

6

A Longitudinal Study of 15 Children with Pica

INTRODUCTION

Having examined two highly selected populations of children—one intellectually retarded and the other socially deprived—and having reached some tentative conclusions, an investigation of an unselected series of children with severe pica seemed essential in order to establish the relative importance of the various factors outlined in the preceding two chapters and possibly identify others that have not as yet been examined.

METHOD

Subjects and the sources of their referral

Fifteen children, 11 boys and 4 girls, in whom the main symptom or one of the main symptoms was pica, were referred to the author by a variety of agencies for further investigation, advice on management and specific treatment if this was necessary. The following were the referral agencies:

- paediatric unit of the local general hospital (1)
- local authority maternity and child welfare department (1)
- paediatric hospital (5)
- general practitioner (2)
- in-patient unit for disturbed children of normal intelligence (1)
- long-stay residential unit for pre-school handicapped children (1)
- paediatric out-patient clinic (1)
- local authority mental health department (2)
- child guidance clinic (1)

In each case a complete history was taken, in a semi-structured interview situation. The design of the questionnaire used is given in Appendix B. This questionnaire was filled in partly during the interview and partly after the interview. All available collateral evidence was obtained from hospital records, health visitor records and from other clinic, school and probation reports.

In several cases the over-all care of the child remained with the referral agency and the author's contribution was of an advisory nature.

All the homes were visited by the author on one or more occasions during the follow-up period. In addition, several subjects and their parents attended the out-patient clinic.

Psychological assessments and speech development reports were made by specialists from these two departments at Queen Mary's Hospital for Children, Carshalton, Surrey. Whenever possible these were repeated during the period of follow-up.

A full physical examination was carried out, height and weight were recorded and previous measurements of heights and weights were obtained if possible, to give an indication of longitudinal development.

Haemoglobin estimation, examination of a blood film and blood lead levels were carried out. When justifiable, abdominal x-rays were taken for evidence of lead ingestion and x-rays of long bones for lead deposition. Where there was a possibility of organic brain damage an EEG was recorded. Scrapings of chewed objects were taken wherever possible and the lead content estimated.

Detailed information was collected about the sibling nearest by age to the subject, concerning intelligence, handicaps, illnesses, accidents, accidental poisoning, early feeding patterns and sleeping difficulties. This group is referred to as the 'control siblings'.

Efforts were made to stop pica by education of the parents, alteration of the environment to alleviate boredom, rehousing, attention to diet and general health, and investigation of the family psychodynamics with superficial interpretive psychotherapy where necessary. Appropriate treatment was given if the blood lead level was raised or anaemia detected.

Fourteen subjects were followed up until pica had ceased completely or had become so slight that it was considered to be no more than occasional mouthing. Pica continued in only 1 child after the period of follow-up, having failed to respond to all available methods of management.

The case histories of the 15 subjects with pica are given in Appendix A and the results of this study are given below.

RESULTS

Intelligence (Tables 6, 7 and 8)

Of the 15 subjects, 11 were thought to have been of normal intelligence before pica began; 6 remained throughout of normal intelligence as assessed by intelligence tests and school records.

Table 6
Approximate Intelligence Level Before, During and After Pica

	<i>Mentally retarded (approx. IQ < 75)</i>	<i>Normal non- verbal intelligence</i>	<i>Normal intelligence</i>	<i>Total</i>
Before pica	4	0	11	15
During pica	7	2	6	15
After pica	6	0	8	14*

* Pica continued in 1 child who was brain damaged.

Table 7
Intelligence—Method of Assessment Before Pica Began or at Onset of Pica

<i>Method of assessment</i>	<i>Number</i>
Assessment on 'milestones' alone	13
Stanford-Binet Intelligence Scale (L-M)	1
Griffiths Mental Development Scale	1

Table 8
Intelligence—Method of Assessment During and After Cessation of Pica

<i>Method of assessment</i>	<i>Number</i>
Griffith's Extension Scale	1
Stanford-Binet Intelligence Scale (L M)	3
Ad hoc scale of functional attainments (Queen Mary's Hospital for Children)	3
Wechsler Intelligence Scale for Children	4
School reports	2
Piaget scale of sensorimotor development	3
Various tests of academic attainment	2
Griffiths Mental Development Scale	4
TOTAL	22

Only one method of assessment was used in 10 children.
Two methods of assessment were used in 3 children.
Three methods of assessment were used in 2 children.

Two subjects tested during the course of pica had a normal non-verbal intelligence but verbal abilities were retarded. Both children were dysphasic and dyslalic (H.C., C.P.). Further intelligence testing showed that in both these children their speech problems resolved during follow-up and they then functioned at normal verbal and non-verbal levels.

Two who were of normal intelligence became brain damaged because of severe lead encephalopathy (subjects S.B., C.B.). One child (M.K.) was accidentally poisoned, presumably due to a paint solvent, and was also brain damaged.

Four subjects were mentally retarded at the time pica began. One child (A.J.), a second twin, sustained perinatal brain damage due to neonatal asphyxia and severe prematurity, and 2 (M.R., J.H.) were retarded but the cause was unknown despite investigation. A fourth mentally retarded child (R.H.) was found to have the characteristic partial deletion of one of the short arms of chromosome No. 5, of the cri-du-chat syndrome. Further assessments of these 4 subjects during follow-up showed that they continued to function at a severely subnormal level.

The methods used to assess intelligence or developmental level are shown in Table 7 (before pica began) and in Table 8 (during pica and after cessation of pica). In many cases where assessment on 'milestones' alone was used to assess developmental level before pica began, information from the parents was substantiated by health visitor reports and hospital records.

All 13 control siblings were of normal intelligence as assessed by developmental level and school progress (where applicable).

PICA

Age at onset and cessation of pica: reasons for termination of follow-up
(Figure 6 and Table 9)

Although defined as clearly as possible, in most cases the onset of pica was gradual and not clearly remembered, because it was initially regarded by most parents as due to teething and a normal developmental stage. In 3 subjects pica was not noticed until poisoning had occurred. This presented as sudden lead encephalopathy in one child, acute accidental poisoning in a second, and general malaise needing investigation in hospital in a third. In the first case, maternal supervision had been adequate but it was later found that the child was eating painted wood heavily contaminated with lead, in the middle of the night (C.B.). In the second case, the mother had schizophrenia and supervision was poor, pica only coming to notice following accidental poisoning. Maternal care of the third subject was poor and he was supervised by an older sibling in a disturbed family situation.

In 2 subjects the onset of pica was sudden (D.B., M.D.). Both were girls of normal intelligence with pre-morbid, shy, sensitive and vulnerable personalities.

At the time of final follow-up only 1 subject still had severe pica. She was mentally retarded following brain damage from accidental poisoning and was in a mental subnormality hospital. In the other 14 subjects pica was no longer present; the shortest length of time that pica had lasted was 3 months, and the longest was 11 years. Mothers of 7 subjects reported that they resorted to

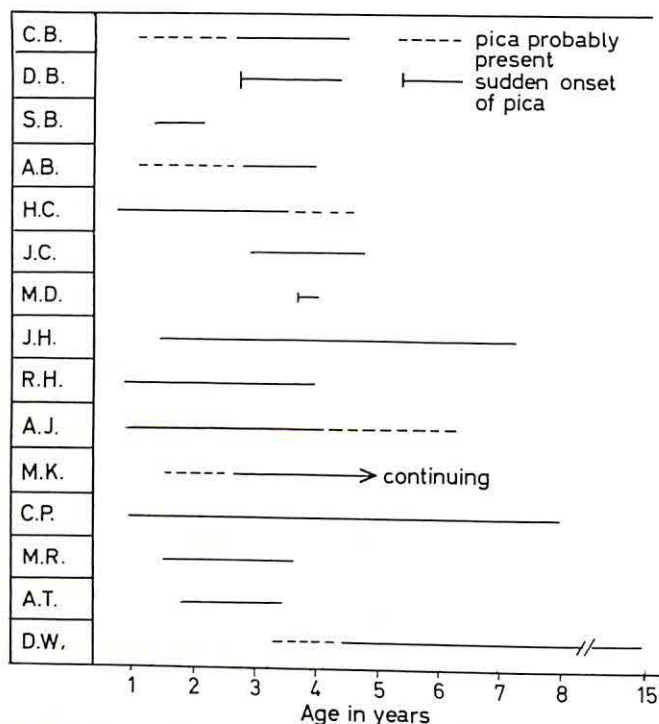


Figure 6. Age at onset and cessation of pica.

Table 9
Reasons for Termination of Follow-up

Reasons	Number
Pica ceased completely	6
Pica minimal and intermittent	7
Pica in certain situations only	1
Admission to subnormality hospital (pica continuing)	1

sucking, chewing and occasionally swallowing inedible substances at times of minor crisis, but in 6 subjects pica had ceased completely and in 1 pica occurred only when she was in her home (Table 9).

Handicaps before, during and after pica (Table 10)

There was no significant physical or emotional handicap detected prior to the onset of pica in 6 subjects. These were families where supervision was poor, and ignorance and poverty were present; pica had not been noticed until the child was poisoned in 3 of these families (C.B., M.K., A.B.).

Speech problems were present in 4 subjects; in 2 the non-verbal intelligence was normal and the speech difficulty was a dyslalia and dysphasia which caused intense frustration over failure of communication. These were both boys who, in their pre-school years, were over-active, noisy, aggressive, spiteful to animals, destructive and rejected by their peers. In both, pica began before they were 12 months of age but was a problem in management after 2 years of age when their behaviour became so difficult. The other 2 subjects with speech problems were mentally retarded but the speech disorder was more severe than could be accounted for by intellectual deficit alone. In 1 there was a complete aphasia and the diagnosis of childhood psychosis had been considered.

Two children were mentally retarded with no additional retardation in speech, but of these 1 was so withdrawn that the tentative diagnosis of childhood psychosis had been made. He was also epileptic. Locomotor development in 3 out of 4 of the retarded children had remained consistently ahead of all their other attainments.

Three subjects of normal intelligence had emotional difficulties at or before the onset of pica. Two were girls who had a neurotic disturbance with nightmares, undue shyness and sensitivity, weeping, phobias and unresolved peer relationship problems. One boy had a serious aggressive behaviour disturbance antedating the onset of pica by approximately one year.

Of the 6 'socially handicapped' subjects who were described as normal before pica began, 3 presented in coma due to poisoning and suffered irreversible brain damage. In the other 3 children increased lead exposure was diagnosed and treated, and brain damage was avoided; they were essentially normal at the final follow-up and were attending infant and junior schools.

The 2 children of normal intelligence but with speech problems did not have raised blood lead levels; with resolution of their speech difficulties, 1 was considered an entirely normal child, but the other remained over-active, distractible and under-functioned at school because of dyslexia as well as behavioural difficulties.

Two mentally retarded subjects with speech problems had moderately raised blood lead levels and were given chelating therapy. There appeared to be no exacerbation of their handicaps and they continued to make slow developmental progress.

Table 10
Handicaps Before, During and After Pica

<i>Handicaps before or at onset of severe pica</i>		<i>Progress</i>	<i>Status of child during or after pica</i>		<i>Highest blood lead levels ($\mu\text{g}/100\text{ ml}$)</i>
<i>Status of child</i>	<i>No.</i>		<i>No.</i>	<i>Comment</i>	
No significant physical or emotional handicap	6		3	Mentally retarded due to poisoning	175 179 42
In general from poor homes with inadequate care			3	Normal development despite moderate lead poisoning	56 90 160
Speech problems $\left\{ \begin{array}{l} \text{Normal non-verbal intelligence and behaviour disturbance} \\ \text{Mental retardation with specific difficulty in speech} \end{array} \right.$	2		2	Improvement in speech and behaviour with special help	30
	2		2	One continued to underfunction at school	29
	2		2	Remained retarded with speech difficulties	62 74
Global mental retardation (one child epileptic and disturbed)	2		1	High blood lead level found at time of second fit	90
			1	First fit occurred during chelating therapy	166
Emotional disturbance and normal intelligence $\left\{ \begin{array}{l} \text{Neurosis} \\ \text{Personality disorder} \end{array} \right.$	2		2	Improvement in neurosis	31 54
	1		1	Sustained head injury, causing deterioration in behaviour and pica. Underfunctioned at school	70

The 2 subjects with global mental retardation had severe pica and high blood lead levels and both children had convulsions at a time when the blood lead level was raised. Both children made slow progress and neither showed regression in any abilities.

One of the girls who suffered from neurosis prior to pica showed a slow improvement in behaviour and pica as various family psychodynamic problems were resolved. The other neurotic girl showed a striking improvement in pica and behaviour when admitted to hospital.

One boy of normal intelligence with a 'psychopathic' behaviour disturbance suffered a head injury 5 years after the onset of pica and this accentuated both his pica and his behaviour disturbance.

Only 1 of the control siblings had a handicap of any kind; he was emotionally disturbed and regarded as maladjusted at school.

Pica—the selectivity, intensity, timing and situation (Tables 11 and 12)

The number of objects bitten, swallowed or sucked were listed and compared. In the majority of children, pica was non-selective although there were usually obvious preferences. In only 3 children were less than 5 substances eaten regularly; in 1 there was selective pica for newsprint, preferably coloured comic paper, and in the other 2 a selective appetite for painted wood and plastic respectively. Each child occasionally chewed other objects.

Most of the oral activity was biting, chewing and swallowing, sucking or licking not being so frequent. Only 1 subject sucked more objects than he chewed, and 6 children were said not to suck inedible objects at all.

The object most frequently chewed was the window-sill (for 6 subjects) followed by toys, painted wood in general, earth, furniture, coal, blankets, shoes, plaster from the wall, newspapers, wallpaper, brittle plastic and carpet. Only 3 subjects had favourite objects to suck: toys, cutlery and the metal fittings in a car. Occasionally the favourite pica object changed over the years, as in 1 child who first chewed painted wood and later ate grease from car wheels or the cooker.

The frequency of pica, resistance to control and the degree of compulsion which the subject displayed in reaching objects to eat were assessed, each on a five-point scale, according to the parents' observations (see Questionnaire, Appendix B). In 1 child this could not be assessed because of the lack of an adequate history. In all children the frequency was at least one to three times each day, and in 5 they were chewing something practically all the time when their pica was at its worst. Most of the parents found their child difficult to control and pica activity was resumed as soon as possible by the child. Most children showed a strong degree of compulsion to chew and to reach the object they wanted. Considerable guile was exercised by parents to cover up, hide or barricade favourite objects for chewing, but the child usually managed to reach

the object he wanted. A frequent comment was that the child had become 'obsessed' or 'addicted' to a certain object, parents and play having become of secondary importance.

Day-to-day variation in pica activity was noted; in 9 children it was worse when they were bored or lonely, and in 1 it was related to both day-dreaming and minor upsets. Pica was not related to mealtimes or to the expectation of food, many children continuing pica activity during a meal. Pica was noted to be at a minimum in 6 children when happy and occupied, but in the rest pica continued when the child was engaged in play or active pursuits.

Table 11
Selectivity of Pica

	<i>Number of objects</i>				
	<i>0-5</i>	<i>6-10</i>	<i>11-15</i>	<i>16-20</i>	<i>> 20</i>
Number of children biting or swallowing objects	3	3	5	3	1
Number of children sucking objects	12	2	0	1	0

Table 12
Intensity of Pica

	<i>Scores</i>					
	<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>	<i>5</i>	<i>IDA</i>
Frequency of pica	0	0	2	7	5	1
Resistance to control	1	1	4	6	2	1
Degree of compulsion	1	3	3	4	3	1

IDA: insufficient details available

Parental reaction to pica

No mother ignored her child's pica once she was aware of it, and the usual reason for taking notice was the damage the child was causing in the home. Thirteen parents responded by reprimand, 9 parents by smacking and shouting and 4 parents (who 'never' smacked their children) shouted only. In addition, 1 parent belittled the child, another was threatened with death and another with a visit to hospital. Only 1 parent (a psychiatric social worker) did not reprimand

or threaten but tried to divert her child's attention. Reprimand was thought to be important by only 2 parents in finally stopping pica.

Positive efforts to change the child's habit of pica had been made by 7 parents. This was by giving the child more love and attention, taking him to a play group or nursery school, or buying suitable toys to occupy him. Five parents had used punitive methods of control in addition to shouting and smacking, such as shutting the child in rooms where there was little to chew, persistent threats and punishment. Most parents had tried to help by getting rid of any furniture that the child liked to chew and replacing the cot by a bed. Favoured objects were hidden and the children were constantly watched. One child was encouraged to suck his bottle, which he did almost all day.

An enquiry was made as to prior knowledge of the dangers of lead poisoning in children; 13 mothers and 1 residential care worker had not realized this danger until it was pointed out by a professional worker. One father was a painter and decorator and his wife knew of the dangers of lead-containing paint in old houses. However, 3 parents were worried because they thought pica resulted in (respectively) worms, heart failure and 'poisoning'.

The parents' ideas were sought on why pica had occurred. Nine parents regarded pica as naughtiness rather than a symptom of unhappiness or illness and they felt that the child was being deliberately annoying. Two of these children were thought to be seeking their parents' attention and this was regarded as bad behaviour, and 5 parents admitted that their children were unoccupied and unstimulated. Two parents regarded this as a prolonged development stage in a handicapped child. Two felt that the main reason was teething. In 2 it was a habit that the child could not break and was likened by the parents to addiction.

Family history of pica and lead poisoning

In 2 families where housing and social problems predominated there were siblings with pica and lead poisoning, discovered soon after the subject was found to have lead poisoning. Both siblings suffered a second episode of lead poisoning during the period of follow-up. In one of these families 2 cousins also had pica and were lead poisoned. One family gave a history of pica in siblings and in one parent, and another child had an uncle with specific pica for cardboard.

FAMILY BACKGROUND

Age of parents at birth of subject (Table 13)

There were no mothers or fathers in the 15-20-year age range when the subject was born, but there were 2 mothers and 3 fathers over 40 years of age.

Table 13
Age of Parents at Birth of Subject

<i>Parental age</i>	<i>15-20</i>	<i>21-25</i>	<i>26-30</i>	<i>31-35</i>	<i>36-40</i>	<i>41-45</i>	<i>ND</i>
No. of mothers	0	3	4	4	1	2	1
No. of fathers	0	2	2	3	4	3	1

ND: no details of parents

Table 14
Education of Parents

<i>Education (score)</i>	<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>	<i>ND</i>
No. of mothers	2	7	2	3	1
No. of fathers	3	5	2	4	1

ND: no details of parents

Education of parents (Table 14)

The parents' education was assessed on a four-point scale, ranging from academic education (1) to little or no education (4). It was not possible to give IQ tests to the parents, but the educational background gives an indication of their abilities or opportunities. Two mothers and 3 fathers had a grammar school education, 2 of the fathers and 1 mother completing a university course. One father who had a university education separated from his wife when the subject was 18 months.

Twelve parents had secondary modern education, 2 were educated in boarding schools, 2 received erratic education in the West Indies, and 7 (3 mothers and 4 fathers) had little education. Two of these 3 mothers were from poor families and 1 was in rural Ireland where little education was available; 2 of them have perpetuated poverty, had large families and married husbands with a similar educational background who have proved to be erratic wage earners and served prison sentences during the period of follow-up.

Family size and position of the subject (Figure 7)

There were more than 4 children in two families, the largest being 8. There was one family in which the subject was the only child of that marriage. Seven subjects were the youngest children in the family.

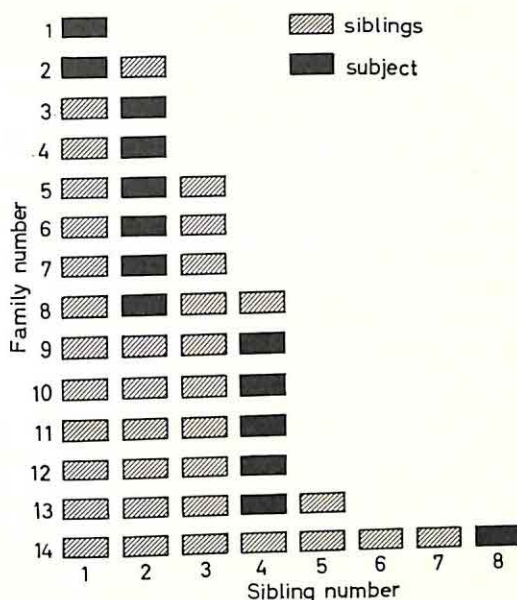


Figure 7. Family size and position of the subject (details not available for one child)

Presence of handicapped or ill adults or children in the family

The assessment of the significance of handicaps or illness was made on whether they had caused a serious disruption of the family dynamics that could have affected the subject. For instance, 2 fathers had war wounds; one had lost an eye, the other had a limp. In neither case did these injuries appear to have affected the welfare of the family and were, therefore, not included.

Serious mental illness had occurred in 3 mothers. In 1 this was schizophrenia, starting 3 months after the subject was born; eventually, after several admissions to hospital, long-term hospital care was needed. Another mother made repeated suicidal attempts, periodically ran away from her family and had an inadequate, hysterical personality. In 1 of these families the care of the children was by the father, and in the other family by the older siblings. One other mother had repeated depressive illnesses. One father had a depressive illness necessitating hospital admission.

Chronic physical illness among parents had occurred in 2 families, in 1 of which both mother and father had chronic gastrointestinal ulceration needing repeated admissions to hospital and loss of time from work. This was the mother of inadequate personality, and the combination of mental and physical illness in this family resulted in disruption of the family and almost non-existent family care. Chronic bronchitis in 1 father was sufficient to cause loss of time

from work and consequent poverty, with lack of clothes and food for the children.

Among all the siblings, 2 were seriously disturbed. These were both brothers of the 2 neurotic girls. One other subject had a younger mentally retarded brother and was retarded himself. In 1 family, with 8 children, the first 7 were either physically handicapped, educationally subnormal, 'delicate' or epileptic. The reason for this accumulation of mild to moderate handicaps was not ascertained because all the children were away at boarding school and most of them went to foster homes during the holidays. The eighth child had pica, but was of normal intelligence and had no physical handicap. In 8 families there was no significant mental or physical illness or handicap in any member of the family, apart from the subject.

HOUSING

Other occupiers

Other occupants of the same house were enquired for as to whether they had an adverse effect on the child. In only 2 families had this occurred. In 1, a schizophrenic tenant had caused unhappiness and stress and appeared to be the major factor in precipitating pica. In another an aged incontinent grandfather was cared for by the mother for the first 2½ years of the subject's life, and the increasing burden of the care precipitated a depressive illness in the mother and the admission of the subject to day nursery. However, pica did not start until 18 months after the death of the grandfather.

Family structure

In 12 families both parents lived with their children. One child who was illegitimate spent his childhood in residential care. In 2 families only one parent was present.

Housing conditions (Table 15)

The general condition of the property was noted, the presence (or absence) of a garden, bathroom and indoor or easily accessible toilet, and the number of rooms. Housing conditions were graded in categories from 1 to 3 (see the questionnaire in Appendix B, and Table 15), category 1 representing those with

Table 15
Housing Conditions

Score	1	2	3	ND
Housing problems	7	3	4	1

ND: no details available

adequate accommodation. In 7 families the accommodation was adequate, in 3 there were some housing problems and 4 families had grossly inadequate accommodation.

Tests for lead in objects within the home

Fourteen samples of objects chewed were removed from 8 homes and analysed for lead. Because of technical difficulties it was not possible for the author to analyse all the specimens ourselves and a few were analysed by the local public health departments. The results are given in Table 16.

Table 16
Results of Tests for Lead in Objects from the Home

<i>Object</i>	<i>Level of lead (g/100 g)</i>
Paint from window-sills	1. 25.0 2. 0.2 3. 1.15 4. Insignificant quantities (less than 0.01)
Plaster from window-sill	1. Insignificant quantities
Wood from window-sill	1. 0.25 2. Insignificant quantities
Paint from cots	1. 26.0 2. 25.0 3. Insignificant quantities 4. 18.0
Tree bark	1. 0.2
Tin of paint	1. Insignificant quantities
Rocking horse	1. 0.20
Radiator paint	1. 0.03
Various toys	All insignificant quantities
Book shelf (painted wood)	1. Insignificant quantities 2. 11.6
The water supply of one home was tested and found to contain insignificant quantities of lead	

It is alarming to note that 3 cots contained dangerously high quantities of lead. All had been bought secondhand and repainted at home.

OCCUPATION OF PARENTS, SOCIAL CLASS AND FINANCIAL DIFFICULTIES (Tables 17, 18 and 19)

The father's occupation was noted and social class accorded within three categories (see the questionnaire in Appendix B and Table 17).

Table 17
Occupation of Fathers by Social Class

<i>Social class</i>			
<i>1</i>	<i>2</i>	<i>3</i>	
<i>(Non-manual)</i>	<i>(Skilled and semi-skilled)</i>	<i>(Unskilled manual)</i>	<i>ND</i>
3	6	4	2

ND: no details available

Two mothers worked in the evening (Table 18) and this had been advised for both to make a break from the subject. Three mothers worked part-time in the day and only 1 mother found it necessary to work full-time because of family financial problems. This subject saw little of his mother because of her long working hours.

The financial situations of the families were assessed on a three-point scale (see the questionnaire in Appendix B and Table 19). In 6 families there were no apparent financial difficulties, the family having an adequate income for their current way of life and the subject causing no special financial problems. However, 2 of these families had housing difficulties and 2 would have moved if there had been equally good employment for the fathers in a different area.

Table 18
Hours of Work by Mothers After Marriage

<i>Type of work (time)</i>	<i>Number</i>
Evening work	2
Part-time day work	3
Full-time day work	1
Housewife only	8
No details available	1

Table 19
Financial Situation

<i>Score</i>	<i>1</i>	<i>2</i>	<i>3</i>	<i>ND</i>
Financial difficulties	6	4	4	1

ND: no details available

In 3 families there were serious financial and housing problems (A.B., J.C., A.T.); they were living in substandard accommodation and in poverty because of irregular wage earning, absenteeism or repeated parental physical illness. In 3 families the fathers had had to change to a less rewarding occupation because of the need to care for the subject at home for part of each day.

THE GEOGRAPHY OF CARE DURING EARLY CHILDHOOD

Each mother was asked whether she looked after the subject consistently in the pre-school years, or whether she was helped by any other person on a regular basis. An assessment was made as to whether this additional person was needed because of maternal inadequacies or peculiar needs of the child, or merely to make the child's life more enjoyable. Only the first 2 reasons were explored further. Episodes of unavoidable mother-child separation were noted, how the child was prepared and whether he reacted adversely during or after the time away from his mother. Finally, the mother was asked whether the child was ever left unsupervised for long periods, either during play or as a punishment.

Main persons caring for subject in early childhood (Table 20)

In 4 families the father played a major part in the upbringing of the subject. In 2 families an older sibling, and in 1 family an aunt, took a lot of responsibility. One subject was cared for by residential child care workers. In the remaining 7 families the mother was consistently present and able to care for her children.

Table 20
Main Persons Caring for Subject in Early Childhood

	<i>Number</i>
Mother only	7
Residential child care workers	1
Father only	1
Father and mother (mother could not manage alone)	3
Older sibling and mother	1
Older sibling alone	1
Aunt and mother	1

Pre-school and school care outside the home (Table 21)

Attendance at a day nursery or play group was arranged for 7 subjects and 4 went on to school during the study. For 1 child day nursery attendance lasted initially only a week because of the severity of pica, but he returned later and

settled well; 1 child was transferred to the special unit of the day nursery because of her intolerably boisterous behaviour and pica. One other was mentally retarded and his pica was fairly easy to control. Four children were admitted to special school (S.S.N.), 2 while in hospital and the other 2 from home; 1 of the latter was excluded because of difficult behaviour. The pica in the children in hospital was noted to improve when fully occupied in school, but no change was noted in the others.

Table 21
Pre-school and School Care Outside the Home

Day nursery or play group	3	1	Excluded but returned later
		1	Transferred to special unit
		1	Mentally retarded
Special school (S.S.N.)	4	1	Excluded because of behaviour
		2	Pica improved
		1	Pica—no change
Day school at 5 years	4	3	Created no major problem—pica had ceased
		1	Had behaviour problems with under-achievement because of behaviour and dyslexia. Pica persisted until 8 years of age
Nursery then day school	4	1	Pica improved; no problem at school
		1	Pica and speech improved; no problem in school
		1	Pica started in nursery; behaviour worse; pica continued to 15 years of age
		1	No improvement in pica or behaviour until admission to hospital; no problem at school

Four children attended day school, not having attended day nursery before. Three created no major problems because their pica had ceased and behaviour was acceptable; in 1 his behaviour was difficult and he was an under-achieving child because of visuomotor difficulties, hyperkinesia and increased distractibility, but his pica slowly improved. Of the 4 subjects who attended a

day nursery, play group or nursery school transferring to day school at 5 years, 2 showed an over-all improvement in behaviour and pica during the time at the nursery and at 5 years they were no problem at school. One did not improve until admitted to hospital; the other subject's pica started at the day nursery, he became aggressive and his behaviour deteriorated during his school years until he was of psychopathic character and eventually on probation.

Episodes of unavoidable mother-child separation

Periods of unavoidable separation had occurred in the pre-school years in 8 subjects, 3 of whom were mentally retarded and had spent some time in special residential units. Five were separated from their mothers during the time of the birth of a sibling. In 3 of these there appeared to have been no adverse effect and the situation was well handled by the parents. The onset of pica was not related to the birth, nor was established pica accentuated at this time. In 2 there appeared to be an adverse reaction on the part of the subject and intense sibling rivalry continued, becoming part of a wider behaviour problem. In both children pica was already present but was not made worse by this event. Three subjects were also admitted to hospital because of illness or for operations. One subject (H.C.) was admitted twice before the age of 5 years but this had no discernible effect on behaviour or pica. One subject admitted for a squint operation at 22 months regressed after this, but his pica had started before and was not made worse. There were no unavoidable episodes of mother-child separation in 7 children.

Enforced loneliness occurred with 4 subjects, and with 2 this occurred at least once every day. Two subjects were shut in rooms or left in their cots; a third subject was shut in because the mother was ashamed of her husband's prison sentence; the other subject was unsupervised because of shortage of staff in the residential nursery and in hospital.

Residential placements outside the home

Of the 4 mentally handicapped subjects, 3 spent some time of their pre-school years in long-stay or short-stay units for subnormal children. All the units were considered progressive, with ample play space and stimulation. One of these subjects eventually needed long-term care. One child lived initially in a less stimulating residential home where his pica started, but this disappeared gradually over a period of 3 years after transfer to a progressive subnormality hospital.

INTRAFAMILY DYNAMICS

Parental competence—material and emotional standards of care (Table 22)

A subjective assessment of parental competence was made following the final follow-up visit to each family. In addition, the mother was asked about her own

feelings of adequacy in coping with the subject and her other children. Of 12 mothers who had more than one child, 10 felt that the normal siblings often suffered at the expense of the child with pica. Often older siblings were given the task of supervision to prevent pica during play, were reprimanded for the subject's behaviour and had little of their parents' time. Two parents felt they could manage all their children and did not neglect one for the other. In 3 families this was not applicable: in 1, where the father was caring for the children, he freely admitted that all were to some extent unsupervised; another subject was in residential care and the third was the only one in the family.

The subjective assessments of emotional and material standards of care were made on a four-point scale (see Appendix B, and Table 22).

Table 22
Subjective Assessment of Material and Emotional Standards of Care

	1	2	3	4	ND
Material standards	3	9	2	0	1
Emotional standards	5	8	0	1	1

ND: no details available

The material standards of child care were thought to be fair to good in 12 families. In only 2 families did subjects show obvious physical neglect and the control sibling was similarly affected. In both families there was parental disharmony, poverty, prison sentences, and lack of supervision. In 13 families the emotional standards of care appeared to be adequate, but in 1 family the child was overtly rejected and the cause of much marital disharmony.

Evidence of disagreement over management of the subject

The degree to which the parents argued about the care of the subject was assessed by interviewing the parents separately and rating the evidence for disagreement on a four-point scale (see Appendix B). In 4 families it appeared that the subject had added to marital disharmony which had pre-existed the problems of the subject. In 1 other family the parents divorced for reasons not involving the child when the subject was 18 months old.

Intersibling dynamics (Table 23)

Unfortunately there was little opportunity to study intersibling dynamics, but an assessment of the reaction of older and younger siblings was made on a three-point scale (see Appendix B) by a combination of the author's own observations and the comments of the mother. Four subjects appeared to fit into the family situation and not arouse extreme sibling rivalry or over-

protection. Three subjects were over-protected by their older siblings; all were mentally handicapped and much-loved members of their families. In 6 families there was evidence of bitter sibling rivalry with spiteful behaviour, clandestine destruction of favourite possessions and fights.

Table 23
Intersibling Dynamics

	<i>No.</i>
Sibling interaction within normal limits	4
Over-protection by older siblings	3
Serious sibling rivalry	6
Not applicable (1 only child; 1 in care)	2

PERSONAL HISTORIES

Pregnancy, delivery and birth weights (Table 24)

Thirteen pregnancies were considered normal, and only 2 abnormal—1 complicated by toxæmia and the other a twin pregnancy. Four deliveries were considered abnormal: 1 followed surgical induction because of toxæmia at 36 weeks, 1 a planned caesarian section, 1 a twin delivery at 36 weeks and 1 a prolonged difficult labour that was probably the cause of brain damage.

Birth weights were assessed in standard deviations according to data by McKeown and Gibson (1951) (Table 24). There were more children with birth

Table 24
Birth Weights by Standard Deviations

<i>Birth weights (SDs)</i>	<i>No.</i>
>2 SDs below mean	3
1-2 SDs below mean	3
Mean to 1 SD below mean	3
Mean	1
Mean to 1 SD above mean	3
1-2 SDs above mean	2
>2 SDs above mean	0

weights below the mean than those above the mean. The 3 subjects with birth weights more than 2 SDs below the mean all had early feeding problems; the smallest of these, a twin, weighed 1.8 kg, the other 2 both weighing 2.3 kg.

Milestones

Motor milestones showed no gross deviations from the normal in 7 subjects (Sheridan, 1968). There was a slight delay in walking in 4 (at 23 months for 1 and at 2 years for 3), but they proved later to be of normal intelligence. In none of these 4 had pica started before they were walking. In 4 mentally retarded subjects motor milestones were delayed, but in 3 their locomotor attainments were in advance of their other abilities.

Speech development was normal in 9 subjects; in 2 it was retarded but other milestones were normal and speech subsequently improved. In 2 of the 4 mentally retarded subjects speech development showed additional retardation.

Toilet training

Nine mothers described themselves as 'easy' parents as far as toilet training was concerned, taking the view that 'it would come naturally'. Seven of their children were slow in toilet training and, of these, 3 were described as negativistic, 3 were retarded and 1 was slow through lack of consistent handling. Of the 5 parents who described themselves as strict, all had children who were toilet trained at the usual time with no difficulty.

Early feeding patterns: the use of comforters

Ten subjects were predominantly bottle-fed and 5 breast-fed. Only 1 subject was given a dummy and accepted it; another subject refused to suck a dummy. Two were left with the teat of their bottles to suck as a comforter. One was not taken off the bottle until 2 years 9 months and another had a bottle each night in bed until 3 years 6 months. One other mentally retarded boy was given his bottle to suck during the day as an alternative to pica and was still drinking all his fluids from this at 8 years. Four control siblings used a dummy but all had given up the habit by 2 years.

Introduction of solid food (Table 25)

All but 1 child was offered semi-solids before the age of 12 months and, of these, 11 had semi-solids before 6 months. This showed no deviation from the pattern of feeding of the control siblings.

FEEDING DIFFICULTIES

Early feeding problems before pica began (Table 26)

Eleven subjects had early feeding problems compared with only 1 control sibling. In 1 subject there was a persistently poor appetite, vomiting and admission to hospital at 8 months and 14 months as a feeding problem. He was a miserable baby, constantly crying and apparently hungry but refusing feeds. In another vomiting was so severe that pyloric stenosis was suspected; he also

Table 25
Introduction of Solid Food

<i>Age in months</i>	<i>No.</i>
0-3	5
4-6	6
7-9	1
10-12	1
13-15	1
Information not available	1

refused to chew solids until 3 years, insisting on a bottle for each meal. There were early feeding problems in each of the 4 retarded subjects; 2 were excessively hungry and 1 of these was persistently sick. All 4 refused to chew lumps from the time solids were introduced until 2 years, 3 years, 5 years and 7 years, respectively, and were therefore fed on purées or finely mashed food. In 2 of these subjects the acceptance of lumps in the food coincided with improvement in their pica. Five other subjects were described as excessively hungry compared with their siblings. The 1 control sibling with an early feeding problem refused food, vomited and was a miserable baby. Gradually, acceptance of food improved and by 3 years her appetite was considered normal.

Table 26
Early Feeding Problems Before Pica Began

<i>Feeding problems</i>	<i>No.</i>
No early feeding problems: solids taken without difficulty	4
Excessively hungry	5
Poor appetite and vomiting: admitted as feeding disorder	1
Severe vomiting: ? pyloric stenosis. Refusal to chew	1
Refusal to chew until between 2 and 7 years. All mentally retarded	4*

* 2 also hungry and 1 with persistent vomiting

Appetite during and after pica (Tables 27 and 28)

Appetites were assessed firstly as to whether they were larger or smaller than the mother would accept as normal, and secondly as to whether they were deviant, i.e. food preferences being so strong that the child would no longer accept the food offered to him. It was found that some children had such

bizarre food preferences that the size of their appetite could no longer be assessed.

Three subjects had appetites that were very small at the time when they indulged in pica (Table 27). One of these had emotional problems and pica for paper and 2 were lead poisoned. In 2 the appetite was small. One subject's appetite remained normal and in 2 it remained almost insatiable: 1 girl would eat her meal but would jump down from the table to eat dirt and so on while continuing with her food. In 7 there was a deviation of appetite. Refusal of solids continued in 5 as before pica started. One subject who became lead poisoned, drank large quantities of milk (up to 3 pints a day) while refusing the family food. Another drank large quantities of milk and water, ate dry bread, faeces and attempted to drink urine (she was of normal intelligence).

In 2 subjects there was a specific behaviour problem associated with mealtimes during the years of pica; 1 child refused to eat his meal with the family and took his food to bed or into the garden, the other became aggressive and destructive at mealtimes and could not sit at the family table.

Of the 14 subjects whose pica had ceased at the end of follow-up, 12 had normal appetites with no deviations.

Table 27
Assessment of Appetite During and After Pica

<i>Appetite</i>	<i>V. small</i>	<i>Small</i>	<i>Normal</i>	<i>Large</i>	<i>Deviant</i>	<i>Total</i>
During pica	3	2	1	2	7	15
After pica	0	0	12	1	1	14
Where pica continued	0	0	0	1	0	1

Table 28 illustrates the change in appetite pattern before, during and after pica. The 6 subjects with deviant appetites or feeding patterns before pica began remained either deviant or poor during pica, but reverted to normal or improved feeding patterns at the time, or soon after, pica ceased. Of the 5 subjects with large appetites, 3 maintained this during pica and 1 of these persisted with pica and a large appetite. The other 2 were seriously lead poisoned and their appetite waned or became deviant. All 4 subjects whose appetites were considered normal before pica began became anorexic in varying degrees and 1 developed a deviant feeding pattern, but appetites reverted to normal at the cessation of pica.

Although only 3 of the highest blood lead levels recorded for each child were below the accepted normal level (36 $\mu\text{g}/100\text{ ml}$), there was an abnormal appetite pattern in all 3, suggesting that distortions of feeding are not dependent on raised blood lead levels.

Table 28
Appetite Before, During and After Pica and Degree of Lead Poisoning

<i>Before pica</i>	<i>During pica</i>	<i>After pica</i>	<i>Highest blood lead levels (µg/100 ml)</i>
Deviant			
Deviant			30
Deviant			90
Deviant	Deviant	Normal	155
Deviant		Deviant but improved	62
Deviant			74
Deviant			
Deviant	Small	Normal	56
Large			
Large	Large	Large	40
Large		Normal	29
			70
Large			
Large	Deviant	Normal	175
Large	Very small	Normal	179
Normal	Deviant	Normal	54
Normal			
Normal	Very small or small	Normal	31
Normal			160
Normal			90

----- pica continuing

ORAL AND OTHER HABITUAL ACTIVITIES (Tables 29 and 30)

Oral and other habitual activities were assessed on a four-point scale, varying from 'rare or never' to 'almost constant'.

Eight out of 15 subjects sucked their fingers or thumb but only 2 did this every day and 1 was described as constantly sucking his thumb. A comfort blanket was used by 3 subjects and in 1 this was carried around during the day. Nail-biting was frequent in 4 subjects but in only 1 child, a girl with neurosis, did this become a serious management problem. One subject sucked a bottle during the day and would carry this around with him. He was mentally retarded and bottle-sucking was encouraged by his mother as a more acceptable alternative to pica. In 1 other subject a bottle was taken to bed each night and this was part of a regressive behaviour pattern following the birth of a sibling. Gum chewing was almost constant in 1 neurotic subject at the onset of pica.

Table 29
Oral Activity

<i>Activity</i>	<i>Score</i>			
	<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>
Thumb or finger sucking	7	6	1	1
Use of a comfort blanket	12	2	1	0
Nail biting	11	1	2	1
Sucking bottle: (a) by day after 3 years	14	0	0	1
(b) in bed at night after 3 years	14	0	1	0
Gum chewing	14	0	0	1

Table 30
Other Habitual Activities

<i>Activity</i>	<i>Score</i>			
	<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>
Head banging	8	4	3	0
Head slapping	12	2	1	0
Self-induced regurgitation	11	2	2	0
Skin picking	13	1	0	1
Teeth grinding	14	0	1	0
Masturbation	14	0	1	0

Activities such as head banging, head slapping, self-induced regurgitation, skin picking and teeth grinding were also assessed. In 3 subjects head banging was frequent and in 1 of these head slapping also occurred. In 4 other subjects this type of behaviour occasionally was noted. Of these 7 subjects, 5 were mentally retarded. Two subjects were known to induce self-regurgitation, and both were neurotic girls of normal intelligence. Skin picking, to the extent of creating semi-chronic sores occurred in only 1 subject, who was mentally retarded. Teeth grinding sufficient to wear down the teeth was noted in 1 subject, who was hyperkinetic with minimal brain damage. Only one parent admitted that masturbation was a common feature of behaviour; this was in 1 of the girls who induced regurgitation.

CONVULSIONS AND ANTICONVULSANT DRUGS

Four subjects had convulsions: 1 during an acute lead encephalopathic illness, 1 during chelating treatment, 1 in whom it was a manifestation of acute poisoning by an unknown substance, and in 1 it was probably a manifestation of pre-existing cerebral abnormality in a severely subnormal child, although his blood lead level was moderately raised at the time of his second fit. All were treated with anticonvulsants, but in 2 subjects they were not needed after the blood lead levels had been reduced to normal.

ILLNESSES (EXCLUDING EPILEPSY), ACCIDENTS AND ACCIDENTAL POISONING (Tables 31 and 32)

The incidence of illnesses, accidents and accidental poisoning in the subject was coupled with the incidence in the sibling nearest by age to the subject. No such sibling was available for comparison with two subjects (S.B., J.H.).

Only 6 subjects had not had a major illness or admission to hospital for an operation. Three had acute lead encephalopathy, 1 had whooping cough undiagnosed and untreated for four weeks at the onset of pica, and a urinary tract infection; 1 was admitted to hospital with pneumonia, 1 with gastroenteritis and 4 had operations. The figures were similar for the siblings, 6 having suffered no major illness or operation.

Repetitive minor symptoms had occurred in 8 subjects. Diarrhoea or constipation had occurred in 5 subjects but was not severe. Five had recurrent tonsillitis, 1 had recurrent tonsillitis and otitis media, which was troublesome during his pica; 4 had headaches, in 2 the headaches followed fractured skulls; 1 had abdominal pain. There were therefore several children with more than one repetitive complaint. A greater incidence of repetitive minor illness was noted in the siblings, only 2 not being affected in this way.

Three subjects had serious accidents. All were involved in road accidents and 1 had three separate accidents in which he sustained fractures each time.

Table 31
Major and Minor Illnesses

	<i>Subject (15)</i>	<i>Nearest sibling (13)</i>
<i>Major illnesses</i>		
Acute lead encephalopathy	3	2
Severe whooping cough	1	3
Urinary tract infection (severe)	1	0
Pneumonia	1	1
Tonsillectomy and adenoidectomy	3	3
Strabismus operation	1	0
Intermittent deafness	0	1
Gastroenteritis (requiring hospital admission)	1	0
Chronic bronchitis	0	1
No major illness	6	6
<i>Repetitive minor illnesses</i>		
Diarrhoea	2	2
Constipation	3	0
Recurrent tonsillitis	5	7
Tonsillitis and otitis media	1	3
Headache	4	4
Abdominal pain	1	0
No repetitive minor illnesses	7	2

He was of normal intelligence but poorly supervised. Only 1 sibling had a serious accident.

Five subjects had episodes of accidental poisoning excluding that due to lead. One took many penicillamine tablets just after lead poisoning had been recognized; 1 swallowed a large number of aspirins and when at the hospital pallor, misery and pica suggested a diagnosis of lead poisoning confirmed by a high blood lead level. One subject was poisoned by an unknown constituent in paint; 1 subject drank bleach, causing corrosion of his lips and yet he asked for more, and the last child, a boy of 11, took aspirins in a suicidal attempt. This followed an episode of lead poisoning which had produced a toxic confusional state in a boy with a serious behaviour disorder. No control siblings had suffered accidental poisoning excluding lead poisoning.

SLEEPING PATTERNS DURING PICA

Disturbed sleeping patterns (Table 33) occurred in 11 subjects, compared with

Table 32
Accidents and Accidental Poisoning

	<i>Subject (15)</i>	<i>Nearest sibling (13)</i>
<i>Accidents (excluding poisoning)</i>		
RTA: multiple abrasions	1	1
RTA: fractured skull*	2	0
Fractured clavicle*	1	0
Fractured humerus*	1	0
No major accidents	12	12
<i>Accidental poisoning (excluding lead poisoning)</i>		
Penicillamine	1	0
Aspirins†	1	0
Paint solvent	1	0
Bleach	1	0
Aspirins (attempted suicide)	1	0
No accidental poisoning	10	13

RTA: road traffic accident

* One subject had a major accident on three separate occasions

† Lead poisoning recognized at this time

Table 33
Sleeping Patterns During Pica

	<i>Number</i>
Bad sleeper; pica mainly at night	2
Nightmares; enuresis; phobias	3
Difficulty in getting to sleep; restless	4
Chewed cot whenever in it	2
Considered no problem by parents	4

only 2 of the control siblings. In many of these children their difficulties resulted in being awake, alone and often fearful during the night.

BEHAVIOUR BEFORE, DURING AND AFTER PICA (Table 34)

Although several of the subjects were very young when pica started the parents were asked to assess whether they were different in their behaviour before pica

Table 34
Behaviour Before, During and After Pica

<i>Before pica</i>	<i>During pica</i>	<i>After pica</i>	<i>Highest blood lead levels ($\mu\text{g}/100\text{ ml}$)</i>
Normal	Normal	Normal	56
Normal			160
Normal	Organic behaviour disorder	Mentally retarded	179
Normal			
Normal			
Normal			
Normal			
Normal, ? disturbed	Neurosis	Improved	29
Normal			
Normal			
Normal			
Normal			
Normal	Disinhibited	Normal	54
Normal			
Normal			
Normal	Withdrawn	Normal	30
Normal			
Mentally retarded	Mentally retarded	Improvement in play, etc.	155
Mentally retarded			
Mentally retarded and withdrawn	Mentally retarded and withdrawn	Improvement in play: more communicative	90
Mentally retarded and withdrawn			
Neurosis	Neurosis worse	Neurosis improved	31

----- pica continuing

began from the pattern set by the older siblings. Their behaviour during the time pica persisted was asked for in detail. The onset of any behaviour disturbance was noted in relation to the onset of pica and, finally, the pattern of behaviour that developed when pica stopped.

Ten subjects were regarded as normal in behaviour before pica began, i.e. the early milestones, sleeping patterns and response to mother contact created no anxiety. Pica started before the age of 12 months in only 2 of these children, so the assessment of normality in behaviour is probably more meaningful for 8. The parents of 3 of these commented on how easy to manage their children had been. Four were obviously retarded before pica began, which for each child was before the age of 20 months. Two of these were withdrawn, manneristic and self-preoccupied. In 1 other subject there was a behaviour disturbance of neurotic type present before pica began.

Behaviour both during and after pica was assessed by the parents as normal in only 2 subjects but these 2 came from poor homes, with inconsistent handling and remarkable tolerance of regressed, destructive and non-conforming behaviour, seen by the observer in the subject and other siblings. Five subjects who had shown normal behaviour developed a pattern described here as an 'organic behaviour disorder'. In the 4 young subjects (2 of whom having suffered an acute lead encephalopathic illness) this was manifested as over-activity, purposeless behaviour, destructiveness, lack of a sense of danger of the degree expected for their age, uncontrolled aggression and regression in speech, toilet training and ability to feed. In 1 older child the behaviour took the form of an aggressive behaviour disturbance with a confusional state after the onset of paint ingestion. In 4 of these subjects poisoning was implicated in the 'organic behaviour disorder', but a similar pattern of behaviour occurred in 1 other in whom poisoning had not been identified, but perinatal brain damage may have been the primary cause. In 1 subject pica and difficult behaviour has continued. The other 4 all have signs of brain damage, but their pica has stopped and all are showing slow improvement in behaviour and intellectual ability.

One subject of previously normal behaviour developed a neurosis at the onset of pica, both persisting and proving difficult to manage, until the family moved house and the child was admitted to hospital. One subject of previously normal behaviour developed an aggressive, disinhibited behaviour pattern, and another became unusually quiet and withdrawn, both abnormal patterns ceasing as the pica diminished and finally stopped.

All 4 mentally retarded subjects were noted to show a sophistication in play at the time their pica ceased and the 2 who were withdrawn became more communicative, more interested and involved in the world around them and simple exploratory behaviour was seen, such as banging on different surfaces, dropping, throwing and placing in and out of containers.

One subject of normal intelligence was phobic and anxious before pica

began; she developed pica at a time of family stress when her neurotic patterns of behaviour became worse, both pica and neurosis improving during hospital admission.

An examination of the highest blood lead level recorded for each child shows no consistent relationship to disturbed behaviour.

CLINICAL EXAMINATIONS AND LABORATORY FINDINGS

Clinical examination

Eleven subjects displayed no abnormal physical signs. One had a cerebellar tremor following acute lead encephalopathy and this resolved slowly over a period of 6 months. One mentally retarded subject had the clinical and chromosomal features of cri-du-chat syndrome and another had a strabismus. One, with minimal brain damage, had choreiform movements.

Electroencephalograms (EEG)

An EEG was requested whenever there was suspicion of organic brain damage. Eight children had this investigation and in 6 it was abnormal. In 1 child focal spikes may have been caused by brain damage following a road traffic accident; in 1 the abnormality was mild and diffuse and perinatal brain damage was suspected; in 2 the diffuse and/or focal slow waves were probably due to lead encephalopathy, and in 2 grand mal interseizure patterns were of doubtful aetiology.

Radiographs of the abdomen and long bones

Twelve children were x-rayed for presence of radio-opaque material in the abdomen. This was found in 5 children, all of whom were known to have eaten painted wood previously. Seven radiographs were negative for this finding. Radiographs of long bones, usually the knee or wrist, revealed lines of increased density at the growing ends in 5 subjects, all of whom showed intra-abdominal radio-opaque material. The blood lead levels of 4 of these 5 children were above 150 $\mu\text{g}/100\text{ ml}$.

Heights and weights (Table 35)

Unfortunately, a reliable measurement of weight was recorded in only 1 child before pica began. He was a feeding problem and considered a failure to thrive, his weight being between percentiles 10 and 25 just before pica began. No child's height was recorded before the onset of pica.

Heights and weights during and after pica showed a wide scatter. No child had a height or weight below percentile 3 during pica, and only 1 child's height and weight were below percentile 3 after pica: he was severely subnormal and often these children show a non-specific growth retardation. Only 3 children had heights and/or weights below percentile 10, during and/or after pica.

Examination of Table 35 reveals that the heights and weights were evenly distributed around percentile 50 for each group of measurements.

Table 35
Heights and Weights During and After Pica

Percentiles	Height*		Weight*	
	During	After	During	After
Less than 3	0	1	0	1
3-10	2	1	1	2
10-25	4	2	3	1
25-50	0	5	3	2
Total below 50	6	9	7	6
50-75	1	1	3	6
75-90	4	2	1	0
90-97	0	1	1	1
Greater than 97	1	1	2	1
Total above 50	6	5	7	8
Not done	3	1	1	1

* Percentiles for height and weight according to Tanner and Whitehouse (1959)

Haemoglobin levels and basophilic stippling of red blood cells

Haemoglobin levels (Table 36) were recorded in only 1 child before pica began. They were between 10.3 g/100 ml (70 per cent) and 11.1 g/100 ml (76 per cent). This subject had been given a poor diet, and intermittent courses of iron therapy had been prescribed since infancy until pica started at 2 years 9 months. However, a poor diet was documented in only 1 other family, and in the other families careful questioning did not reveal any deficiencies in the food offered to the child.

Six children had haemoglobin levels at or below 8.8 g/100 ml (60 per cent) during pica; the lowest was 5.6 g/100 ml (37 per cent). (The haemoglobin was not recorded in 1 subject during pica.) Haemoglobin levels were recorded in 12 subjects soon after pica ceased, in 1 pica continued and in another 2 the investigation was unfortunately omitted. The lowest haemoglobin level was 7.8 g/100 ml (53 per cent).

The relationship of iron therapy to pica and haemoglobin level was also studied (Table 37). Seven subjects were given iron therapy, either orally or by intramuscular injection. In 4 of these children pica continued for several weeks or months after iron was started and the cessation of pica appeared to have no relation to the exhibition of iron; the range of lowest haemoglobins in this group was from 6.7 g/100 ml (46 per cent) to 10.4 g/100 ml (71 per cent). Pica

Table 36
Haemoglobin Levels (as percentages) Before, During and After Pica

	<i>Before</i>		<i>During</i>			<i>After</i>		
C.B.	ND		62	89		86		
D.B.	ND		59			80		
S.B.	ND		49	46	69	70		
A.B.	70	75	71	81		89		
H.C.	ND		ND			76		
J.C.	ND		37			79	90	76
M.D.	ND		46			62	80	
J.H.	ND		69	85		85		
R.H.	ND		81	78	77	ND		
A.J.	ND		70	77		76		
M.K.	ND		73	78		PC		
C.P.	ND		105			ND		
M.R.	ND		80			86		
J.T.	ND		60	92		78		
D.W.	ND		50	72		53	79	

ND: not done

PC: pica continuing

Table 37
Exhibition of Iron Therapy and Relation to Pica

<i>Treatment</i>	<i>Number</i>
Iron therapy given: pica continued, then stopped	4
Iron therapy given: pica continued	1
Iron therapy given: pica improved but relapsed	1
Iron therapy given after pica had stopped	1
Blood transfusion after pica had stopped	1
No iron therapy: pica stopped	7

continued to the end of the study in 1 child despite two courses of intramuscular iron and adequate haemoglobin levels (above 10.5 g/100 ml; 73 per cent). In 1 child pica improved within a few days of the onset of iron therapy, but relapsed later when environmental circumstances changed, despite continuation of iron treatment. Her haemoglobin rose slowly from 7.2 g/100 ml (49 per cent) to 10.1 g/100 ml (69 per cent). In 1 other child iron was given when a haemoglobin of 7.8 g/100 ml (53 per cent) was found after pica had

stopped. One child received a blood transfusion 7 days after admission to hospital (haemoglobin 5.6 g/100 ml; 37 per cent), but his pica had ceased immediately on admission. Seven subjects did not receive iron at any time and their pica eventually ceased, the lowest haemoglobin recorded in this group being 10.1 g/100 ml (69 per cent) and the highest 15.3 g/100 ml (105 per cent).

The haemoglobins recorded are shown in Table 36.

Only 5 children had basophilic stippling of red blood cells, all but 1 having blood lead levels above 100 µg/100 ml.

Blood lead levels

The highest blood lead level for each child has already been recorded in Tables 28 and 34, 12 of the 15 subjects showing by raised blood lead levels evidence of excessive lead ingestion. In 4 of these the highest level recorded was over 150 µg/100 ml, indicating the severity of the condition and the need for immediate therapeutic intervention.

ADVERSE ENVIRONMENTAL FACTORS PRESENT AT THE ONSET OF PICA

In most subjects, therefore, the onset of pica appeared to be multifactorial, involving inner psychodynamic stresses, the presence of handicaps and adverse external environmental factors. Table 38 lists the factors in the environment which appeared to be detrimental to the child and favoured either the onset of pica or the continuation of the normal mouthing phase of development.

Adverse social factors such as old, inadequate housing with lack of space for playing, financial difficulties combined with poor maternal care for physical and emotional needs, and lack of supervision affected the largest group of children. Enforced periods of loneliness when the child was deliberately shut in a room with usually inadequate play material was inflicted on 3 children and another was kept in his cot for excessively long periods. In 6 instances care was inconsistent or non-existent because of parental chronic mental and/or physical illness or because attention was often diverted to a sick, disturbed or retarded sibling. Marital disharmony was present in 4 families during the subjects' period of disturbance, and 1 child was overtly rejected by both parents. Sudden emotional stress appeared to precipitate pica in 2 children.

The quality of care was poor in 2 families and the children acquired various forms of attention-seeking behaviour merely to make their presence felt in the home. For both of these subjects pica produced an immediate response from parents; in 1 this took the form of being picked up and involved in adult activities, and in the other, reprimand.

In only 1 child was iron deficiency anaemia known to be present before pica

Table 38
Adverse Environmental Factors Present at the Onset of Pica

	C.B.	D.B.	S.B.	A.B.	H.C.	J.C.	M.D.	J.H.	R.H.	A.J.	M.K.	C.P.	M.R.	A.T.	D.W.	Totals
<i>Housing and finance</i>																
Old, unsuitable	✓	✓		✓		✓								✓		5
Inadequate play space	✓			✓		✓		✓						✓		5
Serious financial difficulty				✓		✓								✓		3
<i>Parental care</i>																
Lack of supervision	✓			✓							✓			✓		4
Loneliness and isolation								✓	✓					✓		4
Parental mental and/or physical illness (chronic)		✓		✓		✓					✓					5
Parental disagreement concerning subject				✓		✓								✓	✓	4
Parental rejection															✓	1
<i>Other psychological factors</i>																
Sudden emotional stress		✓				✓										2
Attention-seeking behaviour encouraged			✓			✓										2
Presence of ill, retarded or disturbed sibling	✓			✓		✓				✓						4
<i>Physical factors</i>																
Poor diet				✓		✓										2
Iron deficiency anaemia				✓												1
Physical illness																
Physical neglect						✓								✓		2
TOTALS	3	4	1	9	0	7	5	2	1	2	2	0	0	8	2	46
Nil apparent					✓							✓	✓			3

began and in this case it was only mild. Chronic physical illness was present in 2 children at the onset of pica. One had untreated whooping cough and the other had recurrent otitis media and tonsillitis.

Surprisingly, there was no family in which unavoidable mother-child separation or the birth of a sibling contributed to the onset of pica.

In 3 families there were no obvious predisposing environmental factors. These may, of course, have been present but shielded from the observer.

EXTERNAL EVENTS COINCIDING WITH THE CESSATION OR DIMINUTION OF PICA (Table 39)

External events coinciding with the cessation or diminution of pica were assessed in 14 subjects in whom pica had stopped. For 10 children the major change had been admission to a nursery school, paediatric ward or hospital school. For most of these subjects a striking change had taken place from a dull unstimulating life to exciting and stimulating possibilities for play and exploration. Of the 4 children admitted to a paediatric ward, 2 said they preferred living there and did not want to go home. Neither was interested in visits from their parents and 1 actively resented her parents' intrusion in the ward. One child improved when he changed his school from one where he was unhappy and knew himself to be disliked to another where the atmosphere was initially neutral. At the same time this boy formed his first positive relationship with an adult outside the family.

A reorientation of parental attitudes was an important factor in 6 families where the previous attitude, either apathetic, punishing or depriving had been an aggravating factor. It seemed almost certain that a change in parental attitude for the good of the child had occurred to a lesser degree in most of the other families. Removal to a new, more suitable house for the family, the mother leaving work to be at home with the child and positive methods of avoiding loneliness were of major importance in 2 families.

It is interesting to note that only 2 mothers felt that constant reprimand had helped to eliminate the symptom of pica.

In 1 child oral iron therapy coincided with a dramatic improvement in pica. However, she relapsed while still on iron when she returned to her home, but improved again on readmission to hospital.

PERSONALITY PROFILE

Construction of profile

The literature was searched for a behavioural or personality rating scale which would be applicable to the age range of the children with pica, i.e. approximately 2-9 years. Unfortunately, no suitable scale was found.

It was therefore decided to construct a profile for the purpose of this

Table 39
External Events Coinciding with the Cessation or Diminution of Pica

	C.B.	D.B.	S.B.	A.B.	H.C.	J.C.	M.D.	J.H.	R.H.	A.J.	M.K.	C.P.	M.R.	A.T.	D.W.	Totals
Admission to nursery school	✓			✓	✓				✓							4
Admission to paediatric hospital ward		✓	✓			✓	✓							✓		5
Admission to hospital school			✓					✓								2
Change of secondary school															✓	1
Onset of speech therapy					✓											1
Positive relationship with adult outside family															✓	1
Reorientation of parental attitudes	✓				✓	✓			✓			✓		✓		6
Removal to new house										✓						1
Mother giving up work										✓						1
Avoidance of loneliness within the home										✓				✓		2
Effectiveness of constant reprimand						✓				✓						2
The use of a comforter (dummy)			✓													1
Iron therapy			✓													1
Pica continuing											✓					1
No apparent change in external events													✓			1
TOTALS	2	1	4	1	3	3	1	1	2	4	1	1	1	3	2	30

research and to establish norms within the approximate population groups from which the children with pica originated. Ten different aspects of personality as expressed in the behaviour of the child were chosen (see Appendix B). Four statements were then constructed to illustrate varying degrees of the defined behaviour from one extreme to the other, i.e. a two-tailed system. Thus a score of 1 to 4 was given on each of the ten aspects of behaviour.

Use of profile

Each mother was given the profile and an explanatory letter and was asked to ring one of four numbers for each aspect of behaviour corresponding most closely to the behaviour of her child *at that time*.

Personality profiles were completed for all 15 children with pica, either by the mother (14) or by a senior member of the nursing staff (1). These are included with the case histories in Appendix A.

The control groups were obtained from families who lived in the same or similar geographical location as the pica children. Some health visitors, nursery school teachers and school teachers were asked to give the profiles and explanatory letters to parents selected on the following criteria:

- (1) that the parent was likely to co-operate.
- (2) that they had at least one child between the ages of 2 and 9 years.

Collation of data

The control children were then grouped by age from 2-3 years to 8-9 years. The numbers in the groups varied from 13 to 23. The accumulated scores were then calculated for each age group and expressed as a percentage of the number in the group (Tables 40-46). This was considered necessary despite the low numbers because comparisons could then be made between groups and this allowed a uniform method of scoring for each pica child. The possible

Table 40
Personality Profile (norms). Age group: 2-3 years (19 children)

Aspects of behaviour	Total scores (percentage scores)			
	1	2	3	4
I	0 (0)	3 (16)	13 (68)	3 (16)
II	3 (16)	7 (37)	8 (42)	1 (5)
III	4 (22)	13 (68)	1 (5)	1 (5)
IV	1 (5)	8 (43)	9 (47)	1 (5)
V	13 (67)	2 (11)	4 (22)	0 (0)
VI	0 (0)	7 (37)	9 (47)	3 (16)
VII	0 (0)	2 (11)	9 (47)	8 (42)
VIII	5 (26)	4 (22)	7 (36)	3 (16)
IX	1 (5)	8 (42)	8 (42)	2 (11)
X	1 (5)	6 (32)	3 (16)	9 (47)

Table 41

Personality Profile (norms). Age group: 3-4 years (18 children)

<i>Aspects of behaviour</i>	<i>Total scores (percentage scores)</i>			
	<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>
I	1 (6)	3 (16)	12 (67)	2 (11)
II	4 (22)	3 (16)	9 (51)	2 (11)
III	1 (6)	15 (83)	2 (11)	0 (0)
IV	1 (6)	5 (27)	9 (51)	3 (16)
V	10 (56)	5 (28)	3 (16)	0 (0)
VI	1 (6)	2 (11)	9 (50)	6 (33)
VII	0 (0)	3 (16)	8 (45)	7 (39)
VIII	9 (51)	3 (16)	4 (22)	2 (11)
IX	2 (11)	6 (33)	9 (50)	1 (6)
X	2 (11)	7 (39)	2 (11)	7 (39)

Table 42

Personality Profile (norms). Age group: 4-5 years (22 children)

<i>Aspects of behaviour</i>	<i>Total scores (percentage scores)</i>			
	<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>
I	0 (0)	9 (41)	6 (27)	7 (32)
II	3 (13)	11 (51)	6 (27)	2 (9)
III	4 (18)	14 (64)	4 (18)	0 (0)
IV	1 (4)	8 (37)	10 (46)	3 (13)
V	16 (74)	3 (13)	3 (13)	0 (0)
VI	0 (0)	7 (32)	8 (36)	7 (32)
VII	1 (4)	1 (4)	12 (55)	8 (37)
VIII	3 (13)	4 (19)	14 (64)	1 (4)
IX	3 (13)	7 (32)	9 (42)	3 (13)
X	3 (13)	9 (42)	1 (4)	9 (41)

Table 43

Personality Profile (norms). Age group: 5-6 years (23 children)

<i>Aspects of behaviour</i>	<i>Total scores (percentage scores)</i>			
	<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>
I	0 (0)	6 (26)	12 (52)	5 (22)
II	2 (9)	8 (35)	12 (52)	1 (4)
III	3 (13)	19 (83)	1 (4)	0 (0)
IV	2 (8)	6 (26)	12 (53)	3 (13)
V	13 (57)	4 (17)	5 (22)	1 (4)
VI	0 (0)	8 (35)	7 (30)	8 (35)
VII	0 (0)	1 (4)	15 (65)	7 (31)
VIII	7 (31)	3 (13)	8 (34)	5 (22)
IX	2 (9)	11 (47)	8 (35)	2 (9)
X	3 (13)	9 (39)	0 (0)	11 (48)

Table 44
Personality Profile (norms). Age group: 6-7 years (20 children)

<i>Aspects of behaviour</i>	<i>Total scores (percentage scores)</i>			
	<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>
I	0 (0)	5 (25)	11 (55)	4 (20)
II	0 (0)	6 (30)	12 (60)	2 (10)
III	0 (0)	18 (90)	2 (10)	0 (0)
IV	0 (0)	2 (10)	14 (70)	4 (20)
V	9 (45)	7 (35)	4 (20)	0 (0)
VI	0 (0)	2 (10)	9 (45)	9 (45)
VII	1 (5)	0 (0)	14 (70)	5 (25)
VIII	6 (30)	5 (25)	8 (40)	1 (5)
IX	1 (5)	7 (35)	11 (55)	1 (5)
X	0 (0)	8 (40)	3 (15)	9 (45)

Table 45
Personality Profile (norms). Age group: 7-8 years (22 children)

<i>Aspects of behaviour</i>	<i>Total scores (percentage scores)</i>			
	<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>
I	0 (0)	1 (7)	9 (64)	4 (29)
II	1 (7)	2 (14)	8 (57)	3 (22)
III	1 (7)	12 (86)	1 (7)	0 (0)
IV	0 (0)	1 (7)	9 (64)	4 (29)
V	3 (22)	5 (36)	6 (42)	0 (0)
VI	0 (0)	0 (0)	5 (36)	9 (64)
VII	0 (0)	0 (0)	8 (57)	6 (43)
VIII	4 (29)	2 (14)	7 (50)	1 (7)
IX	0 (0)	5 (36)	8 (57)	1 (7)
X	0 (0)	3 (22)	3 (22)	8 (56)

Table 46
Personality Profile (norms). Age groups: 8-9 years (13 children)

<i>Aspects of behaviour</i>	<i>Total scores (percentage scores)</i>			
	<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>
I	0 (0)	4 (30)	8 (62)	1 (8)
II	3 (24)	2 (16)	4 (30)	4 (30)
III	0 (0)	11 (84)	2 (16)	0 (0)
IV	1 (8)	1 (8)	8 (61)	3 (23)
V	3 (24)	4 (30)	5 (38)	1 (8)
VI	0 (0)	1 (8)	2 (16)	10 (76)
VII	0 (0)	1 (8)	7 (53)	5 (39)
VIII	4 (30)	4 (30)	3 (24)	2 (16)
IX	2 (16)	4 (30)	6 (46)	1 (8)
X	1 (8)	4 (30)	0 (0)	8 (62)

deviance or conformity of the child with pica was measured by comparing his score for each behaviour aspect with the distribution of scores within his age group. Any child with pica scoring the same as the first 65 per cent of the control group was regarded as 'conforming'. Any score that fell outside the first 65 per cent of the control group was regarded as 'deviant'. In this way each pica child was given a score in terms of conformity and deviancy. This method of scoring presupposes no inter-relationship between the same scores on any of the ten aspects of behaviour and also allowed cross-sectional examination of score patterns for any particular aspect.

Example:—A hypothetical subject with pica, aged 2 years 6 months, scores 3 on aspect I of behaviour (aggressive—submissive). He is regarded as conforming because 68 per cent of the control group had the same score. On aspect II of behaviour he scores 2. He is again regarded as conforming because the first 65 per cent of the control scores are included in scores 2 and 3. However, on aspect III, he scores 4 and is regarded as deviant.

Table 47
Personality Profile—Conformity and Deviancy Scores.
Children with Pica

	<i>Aspects of behaviour</i>										C D	
	I	II	III	IV	V	VI	VII	VIII	IX	X		
C.B.	D	D	C	D	C	D	D	D	D	D	2	8
D.B.	D	C	D	C	D	C	C	C	D	D	5	5
S.B.	C	C	D	C	C	C	C	D	C	D	7	3
H.C.	D	C	D	D	C	C	C	C	D	D	5	5
J.C.	C	D	D	C	D	D	D	C	D	D	3	7
A.J.	C	D	D	D	C	D	C	C	D	D	4	6
M.K.	D	D	C	D	C	D	C	D	D	D	3	7
D.W.	D	D	D	D	D	D	C	C	D	D	2	8
C	3	3	2	3	5	3	6	5	1	0	31	
D	5	5	6	5	3	5	2	3	7	8		49

C: conformity D: deviancy

Results

The personality profile was completed by random selection for 8 children while pica was still present and for 7 other children after pica had ceased. The conformity/deviancy scores are shown in Tables 47 and 48. The total number of deviancy scores for those with pica (8 children) was 49 and for those without pica (7 children) it was 28. Conversely, those without pica had more conformity scores (42) than those with pica (31). These results would suggest

that the subjects were more disturbed while pica was present than when pica had ceased. When the deviancy scores are compared for each behaviour aspect the most striking difference is seen in aspects IX and X, irritability-affability and obstinacy-amenability.

All the children but 1 with pica were regarded as deviant for aspect IX and all were deviant for aspect X. Among the children whose pica was no longer present, only 3 were deviant for aspect IX and 2 were deviant for aspect X. Both groups had low deviancy scores for aspect V (over-activity-apathy), aspect VII (rigidity-adaptability) and aspect VIII (independence-timidity). Both groups had high deviancy scores for aspect III (attention-seeking-isolated).

Table 48
Personality Profile—Conformity and Deviancy Scores.
Children without Pica

	<i>Aspects of behaviour</i>										<i>C</i>	<i>D</i>
	<i>I</i>	<i>II</i>	<i>III</i>	<i>IV</i>	<i>V</i>	<i>VI</i>	<i>VII</i>	<i>VIII</i>	<i>IX</i>	<i>X</i>		
A.B.	C	C	D	D	D	D	C	C	D	C	5	5
M.D.	D	C	D	D	C	D	C	C	D	C	5	5
J.H.	D	D	D	D	C	C	D	C	C	C	5	5
R.H.	D	D	C	C	D	C	C	C	C	C	7	3
C.P.	C	C	D	D	C	D	C	C	D	C	6	4
M.R.	D	C	C	C	C	C	C	C	C	D	8	2
A.T.	C	D	D	C	C	C	D	C	C	D	6	4
<i>C</i>	3	4	2	3	5	4	5	7	4	5	42	
<i>D</i>	4	3	5	4	2	3	2	0	3	2		28

C: conformity. *D*: deviancy

DISCUSSION

The most striking finding in the results of this study is the heterogeneity of inner psychodynamic stresses, distorted developmental patterns and adverse external factors in the lives of these 15 subjects. All were alike, however, in passing through a phase when their behaviour was dominated by the desire to chew inedible objects.

The majority of the subjects were probably of normal intelligence before pica began and, in those who were retarded, additional problems of communication and behaviour were common. No support, therefore, is offered for the idea that pica is merely a delayed developmental stage in the subnormal child. The children with speech problems were frustrated by their difficulties in

communication and it would suggest that delay in speech development commensurate with mental age is one important antecedent of pica.

Irreversible brain damage occurred in 2 previously normal children following lead poisoning despite modern facilities for investigation and treatment. In others with pre-existing brain damage, superimposed lead intoxication may have been responsible for additional damage. No doubt irreversible pathology would have been more frequent if treatment with chelating agents had been withheld from the other children with raised blood lead levels.

Pica persisted for varying lengths of time and it is surprising to note that in 2 children it lasted 7 years and 11 years, respectively. Many parents had sought help for their children and were often rebuffed by the medical and paramedical professions for bringing this type of behaviour to their attention. There was a lack of awareness of the dangers of pica among professional workers as well as an almost universal ignorance among parents. Parental attitudes to pica were mainly restrictive and punitive, regarding pica as waywardness that would respond to discipline. This had unfortunately been supported by the advice offered by professional workers, although some parents had been helped to a more positive attitude.

One-third of the children came from homes where sociological deficiencies—including housing and financial problems, parental inadequacies whether educational, emotional or physical, and family group instability—were common. Periods of loneliness or lack of occupation were frequent; in some, poor diet and chronic or recurring physical illness in the child added to the constellation of difficulties. However, these gross sociological deficiencies were not present in all families. In several of these 'sociopathic' families there were siblings who had been subjected to the same deficiencies of care and had not developed pica. Sociological deficiencies alone, therefore, do not appear to be sufficient to induce pica in many children (see Chapter 5); neurotic conflicts within the family, unsuccessful competition for attention, sudden external stress and adverse personality or developmental patterns all play a part.

Because the onset of pica has been linked by previous workers to maternal deprivation and to the birth of a younger sibling (Lourie *et al.*, 1958), this was examined, but in this series these factors proved not to be significant. However, in some families there was a disturbed or handicapped sibling competing for the maternal care that was available and no doubt reflecting and adding to the total family psychopathology.

Although the numbers are small, the social classes allocated to the 13 families in which the father was present were compared with the findings of Tizard and Grad (1961) who, using the same criteria, analysed the social class distribution in 250 London families who had a mentally retarded child. In addition, the analysis of social class distribution of a random sample of 500 Nottingham families (Newson and Newson, 1965) are included in Table 49.

The figures from the Newson study are obtained by combining their five social classes into three as used in the present study and by Tizard and Grad.

The social class distribution of the present study and that of Tizard and Grad are similar and, as pointed out by these workers, is probably typical of a random sample of London families. The higher proportion of skilled manual workers in Nottingham may reflect the greater opportunities in that town for the development of skill in industry.

Table 49
Social Class Distribution Compared with other Surveys

<i>Social class</i>	<i>1</i> (%)	<i>2</i> (%)	<i>3</i> (%)
Present survey: total 13 families	23	46	31
Tizard and Grad (1961): total 250 families	28	46	26
Newson and Newson (1965): total 500 families	27	65	8

For most of the children admission to a hospital or the beginning of stimulating day care, usually outside the family, was necessary to break the habit of pica; improvement in pica, appetite and behaviour frequently took place before any treatment had started. Much has been written about the adverse effects of maternal deprivation which may occur in hospital, but for these children the immediate effect of hospital admission appeared wholly beneficial. Parental/child conflicts often crystallized once the child had adapted to a more neutral environment and this provided a suitable starting point for any psychotherapeutic help that was offered.

Non-selective pica was the most common form in children of all levels of intelligence and there was no evidence to suggest that selective pica occurs in the child of higher intelligence. However, the children's preferences were sometimes remarkable. Wood and paint flakes were chosen most frequently. From the histories it would appear that the desire to chew painted wood resulted in anorexia, pallor or behaviour changes, and in some subjects mothers had noticed that a bout of eating paint was followed by a deterioration in his general condition. Tests for lead-containing objects within the home were, unfortunately, erratic because of technical difficulties, but alarmingly high quantities of lead were found in one window-sill and two cots which had been chewed to a marked extent, the children showing preference for this article of furniture rather than for other painted wood.

Pica was not a random activity but a strongly motivated behaviour. Only 1 child was sufficiently co-operative, verbal and intelligent to talk about his habit of chewing brittle plastic and paint flakes. He expressed ideas of wanting to harm himself, but also admitted enjoyment, and some degree of panic that he could not break the habit even when he wanted to. There was no doubt that he could identify by taste, paint with a high lead content.

Disturbed feeding patterns were common and diverse. In two-thirds this was an early development and took the form of insatiable hunger, vomiting or refusal to accept solids. There was also a larger number than expected of small babies in the survey. Many mothers commented on the prolonged conflicts that had occurred in the feeding situation from an early age and were perpetuated in their attempts to manage the pica and the concomitant deviant feeding patterns. In others the feeding disturbances occurred later, at or soon after the onset of pica. Deviant patterns of feeding such as refusal of solids, the drinking of large quantities of milk or water, the ingestion of dry bread and faeces were seen in half the children during pica. While Catzel (1963) suggested that an excessive milk intake and refusal of solids was a common finding in children with pica, there was nothing to suggest from this study that it was universal or that it indicated a specific deficiency. This type of deviant feeding pattern was not confined to the brain damaged or the anaemic, the lead poisoned, or the seriously disturbed. While a large appetite was a common antecedent of pica, a small one frequently occurred during pica and in some children it became almost non-existent, especially if the blood lead level was high. Careful enquiry revealed that the appetite diminished or became more deviant as the pica became worse. Because haemoglobin levels were not available except in 1 patient before and at the time of onset of pica, there is no absolute evidence that iron deficiency anaemia did not exist in the others. The clinical histories, however, suggested that it was the deviant feeding pattern, and in some cases the lead intoxication, that resulted in an iron deficiency anaemia. In 1 child this may have been accentuated by gastrointestinal bleeding due to the ingestion of brittle plastic. The simultaneous resolution of both pica and appetite disorder, often with only a change in environmental circumstances, points once again to a psychogenic aetiology where physical disturbances such as anaemia are concomitant and not causal.

Repetitive minor ailments and major illnesses were common in subjects and siblings, but the most striking finding was that one-third of the subjects had accidental poisoning, excluding lead poisoning, suggesting an indiscriminate or distorted sense of taste combined with a strong desire to ingest.

Disturbance of sleep patterns and behaviour disorders were unusually common in the series. In some children they started before pica, but in most there was a close link with the severity of pica and that of the behavioural pattern. The disturbances were diverse; neurosis, acting out aggressive behaviour, unusual withdrawal and the disintegrated type of disturbance seen

in the brain-damaged child. In some of these children superimposed lead poisoning may have been the major cause of their behaviour disturbance, but some who were severely disturbed were not lead poisoned. Serious sibling rivalry was present in over one-third of the families, resulting in fighting, destruction of toys, punishment by the parents by smacking, threats or separation, leading to loneliness. It was noted that these subjects had great difficulty in making satisfactory peer relationships and even those who were mentally retarded failed to communicate at a level appropriate to their mental age.

It was rewarding to see these various maladaptive patterns of behaviour improve as the child's pica became less, the changes in both pica and behaviour brought about by removal of external stress and support for the personal needs in the child.

The mentally retarded children showed, on the whole, an expected delay in all spheres of development, often more marked in speech, but locomotor development was relatively more advanced. It is probable that the mentally retarded child who fails to learn to communicate, but who can explore his environment effectively because of his mobility, persists in mouthing partly to relieve the frustration of his loneliness and boredom. An improvement in the ability to communicate and a sophistication in play was noted in most of these retarded children as their pica ceased.

Clinical examination of these children revealed that abnormal physical signs were uncommon, but one-half had abnormal EEGs. The heights and weights revealed a large scatter but there was no evidence of overt malnutrition in any child. Iron therapy or blood transfusion was given to 8 children, all of whom had low haemoglobins, but was related to an improvement in pica in only 1 child and that was of a temporary nature.

As the personality profile was completed once only for each child during the survey this allowed an examination of intragroup differences. Despite the variety of behavioural abnormalities seen in the clinical situation, within the whole group there were distinct differences between those whose pica was present and those whose pica had ceased, the former being the more deviant. Both groups, however, were deviant for attention-seeking behaviour, suggesting once again that these children have some basic difficulty in accepting and finding a place in the total family situation.

CONCLUSIONS

(1) The symptom of pica may occur in both the child with normal intelligence and in the mentally retarded.

(2) Despite modern facilities for the maintenance of child health and the diagnosis and treatment of lead poisoning, the dangers of pica are not fully

recognized among professional and lay groups, and lead poisoning leading to irreversible brain damage still occurs.

(3) The cause of pica is multifactorial, involving adverse environmental factors, psychodynamic stresses and distorted developmental patterns. It is usually one of many symptoms of distressed, brain-damaged or retarded children. Physical disease and deficiency states may be important in the minority.

(4) Frequent concomitant findings are a behavioural disorder of varying type, speech and feeding difficulties, which may antedate pica.

(5) While the personalities of the children with pica are varied, certain factors are frequently seen, suggesting an inability to make satisfactory peer relationships.

(6) Pica of this severity is a highly motivated behavioural pattern and not a random activity.

(7) Iron deficiency anaemia is common when pica is severe and is associated with deviant feeding patterns and small appetites. While treatment with iron or blood transfusions may be needed, iron therapy plays little part in the eventual cessation of pica, and in this study iron deficiency was not shown to be a cause of pica.

(8) The dangers of accidental poisoning with substances other than lead must be remembered.

(9) Pica usually resolves when external and internal stresses are modified, and this frequently coincides with an improvement in behaviour and appetite.

(10) The habit of chewing objects in times of stress is seen in many children in whom severe pica has ceased.

7

Final Conclusions and Implications for Future Work

Pica is a symptom that may occur in a vulnerable child who is stressed to the point of developing maladaptive patterns of feeding or other behaviour. But why this peculiar symptom that stimulates revulsion and punishment from their caretakers? Symptom choice often reflects earlier conflict situations or is related to the current developmental level and it would seem that pica is no exception. No particular form of stress has been identified and pica should be regarded as a universally potential maladaptive feeding pattern in childhood. Such a child may come to the notice of a wide variety of child-caring agencies, and perhaps the most striking finding in this study was the almost complete ignorance shown by a wide variety of professions of the dangers of chewing painted wood. It is of vital importance that medical, paramedical, nursing and educational professions are informed of these dangers, and the myth that lead poisoning does not happen in Britain will perhaps be abolished.

IMPLICATIONS FOR FUTURE WORK

(1) The question of importance of *iron deficiency* in the aetiology of pica remains to some extent unsolved by this study because of the lack of haemoglobin levels prior to the onset of pica. However, if iron deficiency is an important antecedent, then children presenting with iron deficiency anaemia, from whatever cause, would be expected to show a high incidence of pica. A further study of this kind still needs to be carried out.

(2) *Speech defects* were seen to be important causes of frustration in 4 children in the longitudinal study, but it is not known how often pica is noted by speech therapists in their speech-retarded child patients.

(3) There is a vast amount of information still to be collected concerning the

role of *heavy metals* in the metabolism of childhood and the way in which increased levels of metals other than lead may exert a toxic effect. Evidence so far (Delves, Bicknell and Clayton, 1972) suggests that other metals may be present in greater than normal amounts in children with pica, but as yet the clinical implications are unknown.

(4) The value of formal *behaviour therapy* in the treatment of pica as a symptom to be eradicated by a system of rewards and punishments was not evaluated in this study but has since been used with success in a 9-year-old girl of normal intelligence, with two episodes of severe lead poisoning and an uncontrollable craving for lead paint. However, the rationale that behaviour shaping occurs by rewarding adaptive behaviour and punishing maladaptive behaviour may explain the apparent success of iron injections in the treatment of pica reported in uncontrolled studies referred to previously (e.g. Lanzkowsky, 1959) since children often view injections as a punishment for wrongdoing. The value of behaviour therapy in certain selected cases, either in a ward situation or modified to suit the home environment, needs to be explored further.

(5) The question of the importance of *chronically raised blood lead level in the mentally retarded child* has not been assessed. At present these children are either unrecognized and therefore untreated, with the possible chance of intellectual deterioration or other signs of encephalopathy, or they are identified and then subjected to repeated courses of expensive and potentially toxic drugs which will have only a temporary effect if the pica remains unaltered. A long-term study of children with such raised blood lead levels needs to be carried out, but the selection of controls and the restriction of other variables make such a study a formidable task.

(6) The EDTA-lead excretion test may be a useful adjunct in the assessment of the body load of lead, but further information needs to be collected from experience with the test in clinical work before its value is finally confirmed.

Appendix A: Case Histories

1. *C.B.* Brain damage following lead poisoning in a previously normal child.
2. *D.B.* Pica and perversion of appetite, with anaemia and increased exposure to lead in the setting of a neurotic behaviour disturbance.
3. *S.B.* Lead encephalopathy following pica. Permanent brain damage sustained.
4. *A.B.* Pica in a socially deprived boy of normal intelligence.
5. *H.C.* Developmental speech disorder and pica with behavioural and feeding problems.
6. *J.C.* Pica, anaemia and lead poisoning in a socially deprived boy of normal intelligence.
7. *M.D.* Pica for paper in a child of normal intelligence with a severe neurotic behaviour disturbance. Family disharmony.
8. *J.H.* Illegitimate, severely subnormal child, with early institutionalization, who developed selective pica for painted wood, resulting in lead poisoning.
9. *R.H.* Cri-du-chat syndrome with mental retardation, pica and specific difficulties in speech and swallowing.
10. *A.J.* Pica and brain damage due to perinatal difficulties (second twin and neonatal asphyxia), resulting in severe subnormality with specific defect in speech and language development.
11. *M.K.* Pica resulting in accidental poisoning and brain damage, severe subnormality and epilepsy.
12. *C.P.* Minimal brain damage with hyperkinesia, pica and a resolving developmental speech disorder. History of possible perinatal brain damage.
13. *M.R.* Severe subnormality of unknown aetiology, epilepsy and increased lead exposure secondary to pica.

14. *A.T.* Pica and lead poisoning in a socially deprived boy of normal intelligence.
15. *D.W.* Aggressive behaviour disorder in a boy of normal intelligence who had pica for plastic and painted wood.

CASE HISTORY OF CHARLES B.

Date of birth: 23 February 1965

Age when referred for investigation: 2 years 7 months

Length of follow-up: 2 years 7 months

General background

Family background

The mother was 28 years at his birth and the father was 31 years. Both parents had received a secondary school education. The mother did an evening cleaning job when the children were small; the father was initially a lorry driver and then became a painter and decorator.

Siblings

The first child, Carol, born in 1964, was attending primary school at the time of final follow-up, and was of normal intelligence. She had two episodes of lead poisoning for which she had received treatment in hospital and made a good recovery. Charles was the second and last child in this family.

Housing and finance

The family's first flat was damp and inadequate for two young children. While living in this flat, Charles became lead poisoned. Examination of the paint on the window-sill that he had chewed revealed a lead content of 25 per cent. When Charles was 2 years 8 months the family moved to another flat which was better although still inadequate, being on the first floor and having an outside toilet, no bath and no garden. The rooms were damp but newly decorated by the parents and appeared well cared for. There were no particular financial difficulties because the father worked long hours to obtain extra money.

Subjective assessment of parental competence

This was a conscientious and loving mother who had a realistic approach to her children and was devoted to them despite the difficulties of housing and Charles's behaviour. She periodically had a reactive depression but this responded to mild tranquillizers. The mother felt that she neglected one child for the other and it was usually Carol who was neglected because of Charles's demands. The father was fond of the children although irritated by Charles's

behaviour and could not cope with him. The parents appeared well suited to each other and only occasionally disagreed over Charles's problems.

Contact with the neighbourhood

This family had become alienated from their neighbours because of Charles's aggressive and destructive behaviour, but the maternal grandparents lived nearby and gave valuable support.

Personal history

Birth and early development

The pregnancy and delivery at full term were normal and the birth weight was 2.7 kg (1-2 SD below the mean). His milestones were normal: he smiled at a few weeks, sat unsupported at 9 months, stood holding on at 10 months, and walked alone at 11 months. His first words were soon after 12 months and he was using understandable sentences at 2 years 6 months. Toilet training was slow because of negativism but progressed until his illness at 2 years 7 months.

He was bottle-fed by the clock and was not given a dummy; solids were started at 6 weeks. He always had a large appetite, with no food fads. He started feeding himself with a spoon at 18 months and managed a cup at 2 years. Initially there were no sleeping problems. He was an exceptionally easy child to care for before his illness.

Childhood separations and periods of loneliness

Charles was cared for occasionally by his maternal grandmother and his father while his mother was at work. Before his episode of lead poisoning the children spent a lot of time in unsupervised play but, following this illness, his lack of sense of danger made it difficult for him to be left alone. However, his behaviour was then so bad that mother would shut him away when she could cope no longer.

Pica

Charles's pica was not noticed by his parents until he was severely lead poisoned. At the age of 2 years and 7 months he became unconscious in a shop and was taken to hospital where this diagnosis was made. When the home was investigated, teeth marks were found on the under-surface of several window-sills. This chewing had never been noticed by his parents and almost certainly he had been doing it at night. In retrospect, his mother thought that he had become more irritable and bad tempered for the month preceding his sudden collapse. He had also developed an insatiable desire for milk and would drink two to three pints a day.

On admission to hospital

When admitted to hospital he was comatose with a fixed stare to the left. His blood lead level was 175 $\mu\text{g}/100\text{ ml}$. Lumbar puncture revealed a raised

cerebrospinal fluid pressure. X-ray of his abdomen showed radio-opaque material in the intestine and his long bones showed increased density at the growing ends. His haemoglobin was 9.1 g/100 ml (62 per cent), reticulocytes 9.4 per cent and the red cells showed basophilic stippling.

There was a delay in making the diagnosis because of the uninformative history but treatment with calcium EDTA and penicillamine was started when the raised blood lead level was found. By the fifth day he was fully conscious, hyperkinetic and had an incongruous affect. He had lost his speech and started to have convulsions. An EEG was suggestive of toxic brain damage.

After 28 days his blood lead level was 60 $\mu\text{g}/100\text{ ml}$ and he was discharged home. He was placed on anticonvulsants, but these were stopped after a few months and he had not had further fits at the age of 5 years 2 months.

Accidental poisoning

He was readmitted to hospital two months after the first admission because of an accidental overdose of penicillamine. These tablets had been placed in a biscuit tin where he found them and ate a handful.

Psychological assessment

This was attempted following his recovery from coma, but he was found untestable because of his distractibility, destructive behaviour and hyperkinesis. Two years later, at the age of 4 years 7 months, an assessment of intelligence on the Griffiths Extension Scale revealed a GQ of 71. His hearing was tested and found normal.

Progress after discharge from hospital

During his admission to hospital his parents moved to a different flat and repainted it in an attempt to cover up any lead that may have been there. The water supply of this house was tested and found to be normal. Charles continued to behave in a wild, hyperkinetic fashion and was a continual trial to his parents. His pica remained severe. He ate the window-sills, especially at night, and would climb to find new areas of painted wood. He ate ashes from the grate, crayons, pencils and clothes-pegs, chewed his blankets, would bite off and swallow buttons from his own garments, kneel and chew the carpet or rug, destroyed his own clothing by chewing and would eat coal and earth. He chewed wooden furniture and ate matches, newspapers, plastic toys and the soles of his own shoes. He ate towels, sucked at his face-cloth and would suck at a bar of soap. He tore wallpaper off the wall to eat. He would go outside and search for painted sticks and bring them into the house to chew. He had some object in his mouth practically all the time. When made to stop he would resume immediately and throw a tantrum if taken away from the object.

His parents felt that he used this behaviour to seek attention, but also he behaved as though he were addicted to painted wood. It was related partly to

boredom but, as he was a child showing no initiative in play and had alienated himself from his peers, it was difficult to keep him occupied.

His parents responded to his pica by smacking and threatening to send him to the hospital. They were concerned about a possible recurrence of lead poisoning and were continually anxious for his welfare. They had tried to prevent his pica by barricades, and finally tried to get him admitted to a nursery school.

Initially he made almost no developmental progress following the episode of lead encephalopathy. His speech remained restricted to a few unclear single words. He was doubly incontinent, only occasionally responding to potting. He would not use a spoon and insisted on finger-feeding. He refused to help with dressing and undressing. His locomotor abilities remained good. He was agile, could climb, run and manage stairs easily. Fine motor movements were also unimpaired. He scribbled, managed simple jigsaws and could pour milk accurately from a bottle into a cup. He continued to use a comfort blanket each night, sucked his thumb or fingers occasionally, banged his head when in tantrums, rocked and showed hand mannerisms. He was a bad sleeper, restless and wakeful. He had temper tantrums, when he would become aggressive and destructive.

He was admitted to a day nursery at the age of 3 years 10 months but was continually chewing the equipment, fighting and kicking and was excluded after one week. Tranquillizers were tried with no effect. He was spiteful, disobedient and negative, yet still remained an affectionate child.

At 3 years 11 months his blood lead level was 82 $\mu\text{g}/100\text{ ml}$. A further course of treatment with penicillamine was instituted. At this time his height was between percentiles 10 and 25, and his weight was between percentiles 25 and 50. At 4 years 3 months his haemoglobin was 13.0 g/100 ml (89 per cent) and blood lead level 65 $\mu\text{g}/100\text{ ml}$.

He remained hyperkinetic, had no sense of danger or fear and was knocked down by a car at the age of 4 years 3 months.

At the age of 4 years 7 months he was admitted to a play group for disturbed children, for three mornings a week, and subsequently attended full-time. Two months later his mother noted a great improvement in his behaviour. He played constructively, was not so aggressive, his speech had improved and he was toilet trained. He stopped drinking large quantities of milk, his appetite increased and his pica improved so that this was no longer a major problem in management. At times of stress he would resort to chewing painted wood, but did not do this when happily occupied. His blood lead was then 60 $\mu\text{g}/100\text{ ml}$ and his haemoglobin 12.5 g/100 ml (86 per cent).

At a final follow-up at 5 years 2 months he was awaiting admission to an assessment unit in the local infant school. His blood lead level was then 40 $\mu\text{g}/100\text{ ml}$. He was no longer indulging in pica, his appetite was normal and his behaviour acceptable for his reduced intellectual level.

Diagnosis

Brain damage following lead poisoning in a previously normal child.

Charles B.
Aged 4 years.

Personality profile

After lead encephalopathy, pica present.

Aggressive				Submissive
Noisy				Quiet
Attention seeking				Isolated
Disobedience				Passivity
Over-activity				Apathy
Destructive				Not destructive
Rigidity				Adaptability
Independence				Timidity
Irritability				Affability
Obstinacy				Amenability

CASE HISTORY OF DIANE B.

Date of birth: 7 May 1965

Age when referred for investigation: 4 years 2 months

Length of follow-up: 15 months

General background

Family background

The father was aged 33 years at the birth of Diane and the mother 30 years. Both were in good health. The father worked as an accounts clerk during the day and as a musician for three evenings at the week-end. He appeared of average intelligence. The mother had depressive episodes, at first associated with pregnancy, but became worse with a severe degree of apathy, compulsive eating and gross obesity after Diane developed pica. At one stage she weighed almost 20 stone (127 kg):

Siblings

There were four children in this family, Diane being the third; the first two, a half-sister and a full brother, attended the local junior school. The brother had intermittent deafness, failed to progress at school and was a serious behaviour problem. The youngest child, 1 year old, was healthy and normal.

Housing and finance

The housing conditions were appallingly bad. The family rented a furnished flat; some floor boards were burned and had not been replaced, the wallpaper was peeling off and the walls were covered with fungus. The bathroom, garden and toilet were shared with the other tenant, who was schizophrenic. Their financial position was adequate for daily needs but they have never had enough money to buy a place of their own. The family were rehoused during the period of follow-up, in a poor but adequate council house, with a bathroom and garden.

Subjective assessment of parental competence

The mother appeared well able to care for her family and she was diligent and loving when not depressed. She managed the exasperating problems which the other tenant created. The father saw very little of his children but was fond of them, Diane being the favourite.

Contact with the neighbourhood

The family felt they were gradually being alienated from their friends by the strange behaviour of the other tenant. No longer were the children allowed to bring in their friends and so had few invitations in return. However, immediate

good rapport was established with the neighbours when they moved to the council estate.

Personal history

Birth and early development

The pregnancy was complicated by toxæmia but delivery was normal following induction at 36 weeks. Birth weight was 3.2 kg (mean to 1 SD above the mean). There were no neonatal problems. The baby was breast-fed for one week and because of milk failure at 8 days was then fed with cow's milk. She sat at 8 months and walked rather late, at 2 years. Toilet training progressed normally and at 18 months she was said to be clean and dry with regular potting. Her first words were at 9 months and she made short phrases at 18 months. Solids were introduced at 4 months; there were no difficulties and she began to chew at the usual time.

Childhood separations

She was separated from her mother during the latter's admission to hospital for the birth of the fourth child. Her behaviour problems had become evident by this time but improved while staying with her grandmother and she did not want to return home. She started to attend a private play group three mornings a week from 3 years.

Behavioural difficulties

Her development appeared to be normal until, at 2 years 11 months, she became shy and clinging. She started to chew the woodwork, sucked her thumb, developed nocturnal and diurnal enuresis and stammering started soon after. She was aggressive towards her older brother and, later on, the baby. She became increasingly unhappy, desirous of her mother's attention and could not tolerate reprimand. She repeatedly woke up screaming, following nightmares. She became a solitary child, actively avoiding the company of children and adults, apart from her mother, and indulged in morbid make-believe play.

The precipitating factor for the general behaviour disturbance and pica appeared to be the schizophrenic tenant who had frightened Diane by rushing into her bedroom and gesticulating. He continued to menace the children, standing in their passage-way or sitting on the stairs. He removed lightbulbs and locks. He undressed the baby and took away the older children's toys.

Pica

Pica started at this time of general disturbance. She began by chewing the woodwork in the flat, particularly the window-sills and the plaster surrounding them. She ate newspapers and comics and later started to tear off the wallpaper to eat. She chewed paper tissues and paper on which she had drawn a picture and would chew at a paintbrush. The pica was related to being upset, to day-

dreaming and possibly to frustration, but she would also eat paper when fully occupied at the play group.

Feeding difficulties

After her pica had started she became apathetic about eating and occasionally refused a whole meal even when it was food she liked. The mother cooked special meals that Diane chose, in an attempt to help her eat. She developed a liking for dry bread and would drink two to three pints of milk a day, and up to six pints of water a day.

On examination

Diane was a bitterly unhappy child who clung to her mother and ate paper tissues during the out-patient session. No physical abnormalities were found.

Investigations

At 4 years 2 months her haemoglobin was 8.6 g/100 ml (59 per cent) and her blood lead was 54 µg/100 ml. She was treated for 6 weeks with ferrous gluconate and penicillamine 300 mg b.d. with pyridoxine 20 mg b.d. Her height was between percentiles 10 and 25, and her weight was between percentiles 75 and 90.

Psychological assessment

This was difficult because of her distressed state, but with minimum co-operation she obtained an IQ of 95 (mental age 4 years) on the Stanford-Binet Intelligence Scale (L-M). Her chronological age was 4 years 2 months. During this session she showed visual avoidance, constantly sucked her fingers and buried her head in her mother's lap every time she was asked to co-operate.

Progress

Four months later, despite iron therapy she still showed severe pica for earth, wood, paper and cloth, and her appetite for milk, water and dry bread continued. She had started to play with her faeces and suck her wet knickers. She still had little appetite for family meals. She remained miserable and shy, but spiteful to her younger brother.

Because of the severity of the feeding disturbance she was admitted to hospital for further investigation.

Investigations

Her haemoglobin was 11.7 g/100 ml (80 per cent) and her blood lead level was 45 µg/100 ml. A stool specimen revealed threadworms and her white cell count showed 22 per cent eosinophilia. An EEG was abnormal, suggesting several long-standing epileptogenic areas.

Diane B.
Aged 4 years.

Personality profile

Neurotic behaviour disturbance. Pica present.

Aggressive					Submissive
Noisy					Quiet
Attention seeking					Isolated
Disobedience					Passivity
Over-activity					Apathy
Destructive					Not destructive
Rigidity					Adaptability
Independence					Timidity
Irritability					Affability
Obstinacy					Amenability

Treatment and progress

She settled in the ward and showed no pica during the two weeks in hospital. She played with the other children, had a normal appetite and showed no behavioural abnormalities. She was given treatment for threadworms. She was discharged, with the recommendation for admission to a nursery school, which however was not implemented.

Follow-up for nine months after discharge from hospital revealed that Diane maintained her over-all improvement in behaviour and feeding habits.

She chewed pencils only at times of distress and her appetite was good. She became an outgoing, affectionate, talkative child who often expressed disgust at her own previous feeding habits. She had attended an infant school from the age of 5 years and was considered a normal child.

Diagnosis

Pica and perversion of appetite, with anaemia and increased exposure to lead in the setting of a neurotic behaviour disturbance.

CASE HISTORY OF SUSAN B.

Date of birth: 25 September 1967

Age when referred for investigation: 1 year 9 months

Length of follow-up: 15 months

General background

Family background

The mother was aged 28 years and the father 34 years at the birth of Susan. Both were in good mental and physical health. The mother had had a commercial training and worked as a caretaker, mornings and evenings, in the club in which they lived. The father had had a secondary modern school education and worked full-time as a caretaker.

Siblings

There was only one child by this marriage, but the mother had four children, no longer living with her, by a previous marriage.

Housing and finance

The family lived in a self-contained flat on the first floor of a large non-residential men's club. It was built at the beginning of the century and had been repainted on many occasions but the old paint was never burned off. However, examination of the lead content of paint chippings, where Susan had chewed, revealed concentrations not above 2 per cent. Many of the rooms, the staircase and the hall were in a bad state of decoration. An interview with the builder who had supervised these premises for the past 20 years revealed that, following Susan's illness, they had decided to burn off the old paint from all the window-sills that she could reach and replace it with a hard plastic paint. There were no particular financial problems in the family.

Subjective assessment of parental competence

The parents appeared competent in their handling of Susan. However, the total atmosphere of the home was artificial, with little discipline, and attention-

seeking behaviour was encouraged by the admiring adults in the club. The parents admitted to only occasional disagreement over the handling of the child.

Contact with the neighbourhood

The immediate contact for this family was with the many club members who came to spend the evenings there. Both parents seemed outgoing and friendly, enjoying club life.

Personal history

Birth and early development

The pregnancy was uneventful and delivery was normal at home at 40 weeks. Susan's birth weight was 2.3 kg (more than 2 SDs below the mean). She was bottle-fed on demand and was a hungry baby. Solids were started at 3 months and there were no difficulties. She managed a cup and spoon at 18 months. She smiled early, sat unsupported at 7 months, stood holding on to furniture at 11 months and walked alone at 13 months. Her first words were 'Dad' and 'Mum' at 13 months, and at 15 months she had 4 recognizable words which she used appropriately. There were no problems with sleeping; she had no significant illnesses before the onset of lead poisoning and there were no convulsions. There were no bowel disturbances and the mother decided to begin toilet training at 17 months just before Susan became ill.

Childhood separations and periods of loneliness

There were no episodes of mother/child separation, and she had not attended a day nursery. The mother had Susan with her when she worked during the morning in the club. Susan apparently enjoyed this and was a great favourite with the other workers and members of the club. She was described as a friendly, outgoing child who sought adult attention. Susan was, therefore, constantly in the company of adults and was at no time unsupervised until her pica was severe, when she avoided the attention of adults so that she could chew the window-sills. She had a sleep each afternoon for 1 hour but, as soon as she woke up and cried, she was lifted out of her cot. Similarly, she was not left in her cot in the morning once awake.

Pica

Chewing of her cot occurred at the age of 18 months when she was put down to sleep. Her molars were then erupting and her parents thought that she was chewing her cot because of this. The lead content of the paint on some rungs of the cot was found later to be as high as 26 per cent. They bought her teething rings but she was not interested in them. She then began chewing the window-sills in two different rooms. These were dirty and needed repainting. Whenever in the garden she would eat earth and eventually could not be left

there unsupervised. Chewing of her cot became severe and, despite covering the rungs with plastic, she still managed to get to the wood (*Figure 8*). She then started to chew broom handles and picked up the linoleum to chew. She would get into the broom cupboard and lick the dirt off the floor. She also chewed blankets, buttons, the carpet, ballpoint pens, cigarette stubs (which were abundant in the club), her own shoes, clothes, plastic toys and soap. It was painted wood, however, that was her main interest.

During the following three months her pica became more persistent until she was chewing something all the time. When told to stop she resumed immediately and, if taken from one window-sill, she would have a tantrum and go to the other. If these were barricaded with chairs she would attempt to remove them. Her pica appeared to have no particular relationship to loneliness or boredom.

Her parents initially reacted by smacking, which was found not to be effective, and they eventually tried to restrict her environment so there was little she could chew. They were anxious about the symptom because of the concomitant misery and behavioural change, but were not aware of the dangers of lead in paint. Just before hospital admission she was constantly

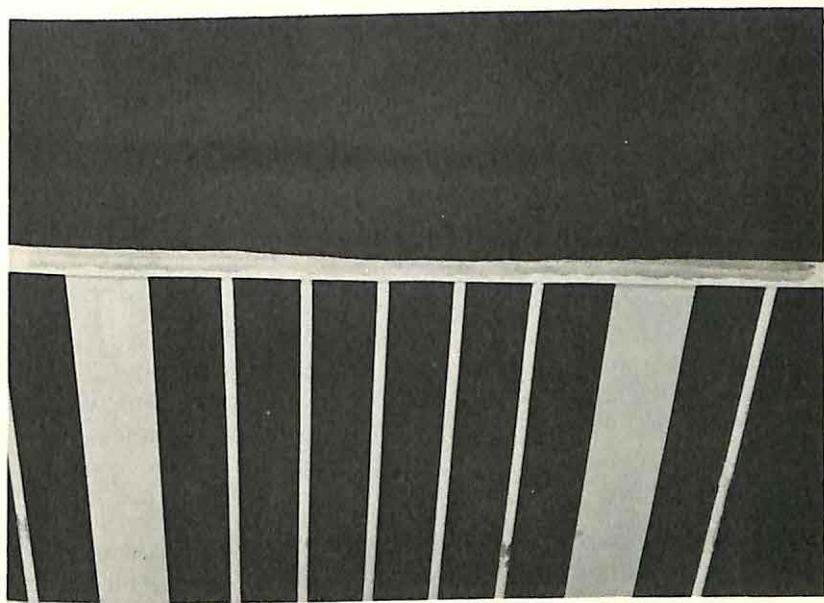


Figure 8. Chewed cot. Paint contained lead concentration of 26 per cent (Susan B., aged 21 months)

biting at anything, including her mother. The night before admission, when she was in a pre-coma and appeared not to be able to see, she was still trying to bite the paint from the bedroom door.

Feeding problems

Her hunger as a baby had been ascribed to being underweight at birth and she was fed with as much as she would take. She was left with her bottle in her pram or cot and would suck it avidly. No dummies were used but the teat on her bottle seemed to act as a comforter whenever she was distressed or cross. From 8 months she developed a dislike of eggs but enjoyed meat, milk and cheese. By comparison with her previous four children, the mother felt that Susan's appetite was good until six weeks before admission to hospital, which was six weeks after her pica began.

Behaviour

The mother described Susan, until the age of 18 months, as one of the easiest children she had had. After her pica began she became miserable, sleepy, less friendly and actively avoided the company of adults, so that she could chew painted wood.

Onset of lead poisoning

In retrospect the first symptoms described were anorexia, vomiting and lethargy, starting six weeks after pica began. The diagnosis of lead poisoning was not made at this time and pica continued with increasing severity for a further six weeks during which she remained totally anorexic, miserable, sleepy and lost her smile. Her pica became more specific and painted wood seemed her main interest. Her parents likened her state to one of addiction where the substance she craved for appeared to be killing her. She also started to rock and head roll and seemed unsteady on her feet.

Admission to hospital

At 21 months a further episode of vomiting and extreme drowsiness precipitated admission to hospital. She was a severely ill, pale, photophobic child with a tremor of the limbs and a high-pitched cry. She persistently vomited all fluids given to her. Physical examination revealed broad epicanthic folds (Figure 9).

Investigations

Her weight was between percentiles 10 and 25, and her height was between percentiles 50 and 75. Her blood lead level was found to be 179 $\mu\text{g}/100\text{ ml}$ and her haemoglobin was 7.2 g/100 ml (49 per cent). The blood film showed basophilic stippling. X-ray of her abdomen revealed high-density radio-opaque bodies in the bowel and x-ray of the long bones showed increased density at the

growing ends. Her urine revealed a gross aminoaciduria. Repeated EEGs showed a diffuse abnormality with an excess of slow activity.

A diagnosis of lead encephalopathy was made.

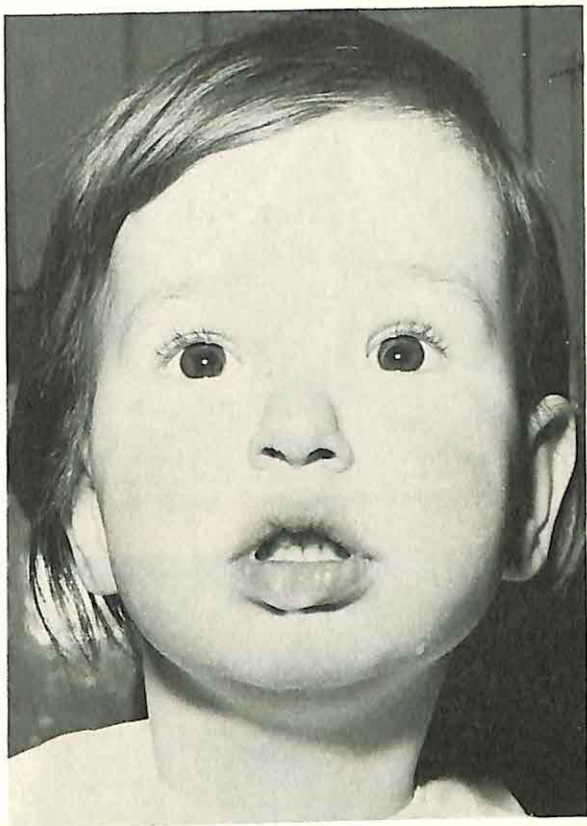


Figure 9. Facial appearance of Susan B., aged 21 months

Treatment and progress

She was treated with penicillamine, pyridoxine and extra milk and her blood lead level gradually fell. Her mental state improved and she began to recognize her parents, was more steady on her feet, her tremor disappeared and she began to babble once more. Her appetite steadily improved. However, she continued to bite the bars of her cot, her clothes, toys and other children (Figures 10 and 11).

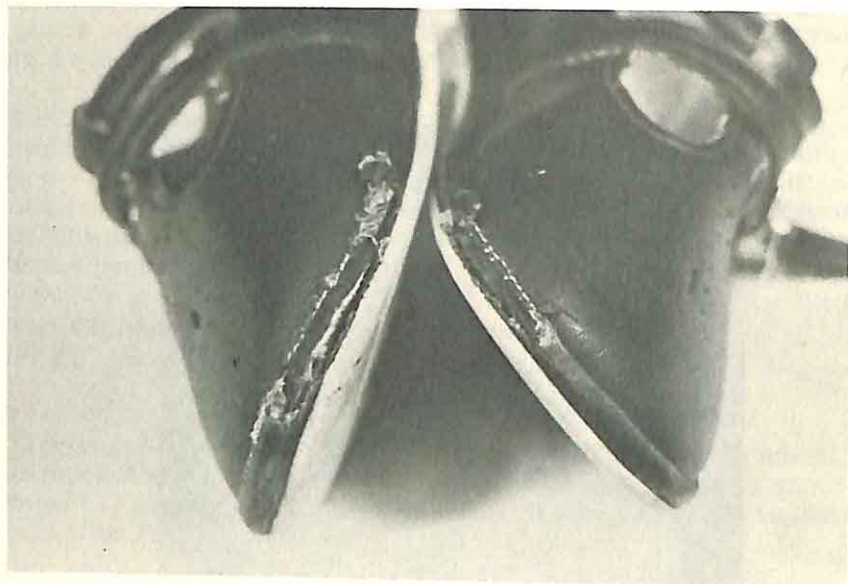


Figure 10. Chewed shoes (Susan B., aged 22 months)

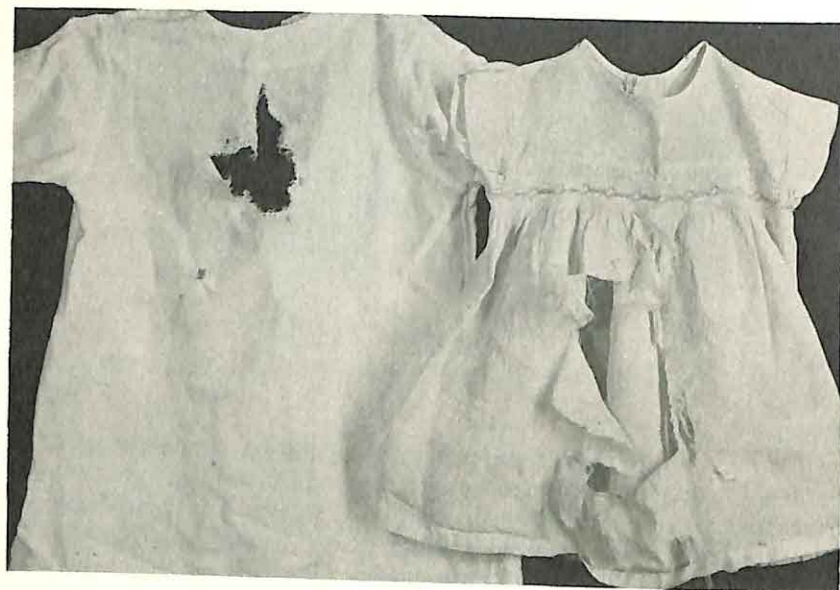


Figure 11. Chewed dress and nightdress (Susan B., aged 22 months)

Her pica necessitated constant supervision and at times of staff shortage she was placed in her cot to prevent her chewing the woodwork. This meant she received little stimulation and resorted to chewing the hospital cot.

Six weeks after admission, her blood lead level was $75 \mu\text{g}/100 \text{ ml}$ and her haemoglobin was then $10.1 \text{ g}/100 \text{ ml}$ (69 per cent). This rise in haemoglobin had occurred without iron therapy. Regular examination of early morning specimens of urine while on treatment showed a lead level of approximately $2,000 \mu\text{g}/\text{l}$.

Susan B.

Aged 2 years.

Personality profile

After lead encephalopathy. Pica present.

Aggressive					Submissive
Noisy					Quiet
Attention seeking					Isolated
Disobedience					Passivity
Over-activity					Apathy
Destructive					Not destructive
Rigidity					Adaptability
Independence					Timidity
Irritability					Affability
Obstinacy					Amenability

Two months after admission she began to attend the nursery class of the hospital special school. Her play was observed and predominance of oral exploration was noted. Her manipulation of toys was at a simple level and no constructive play was seen. She was given a dummy to suck and she then began to develop her manual skills and started exploring toys with her hands. It was at this time that the first improvement in her pica was noted.

She remained on chelating therapy for the following two months but her blood lead level remained between 70 and 100 $\mu\text{g}/100\text{ ml}$. Her haemoglobin remained between 9.1 g/100 ml (62 per cent) and 10.1 g/100 ml (69 per cent). In addition, her clinical state was unchanged. Her pica persisted to a moderate degree, her appetite was poor and there was no speech. Developmental assessment at this stage revealed a level of approximately 12–15 months, apart from locomotor development that was more advanced and speech that was more retarded (Ad Hoc Developmental Scale of Functional Attainments).

Treatment with ferrous gluconate was then started and there followed a clinical and behavioural improvement. Her appetite increased, her pica became almost non-existent and her play was more purposeful.

One month later it was decided to allow her home for two separate days each week while she remained on iron and chelating therapy. However, her pica returned after each day at home. At this stage her haemoglobin was 10.1 g/100 ml (69 per cent) and her blood lead level was 95 $\mu\text{g}/100\text{ ml}$.

At 2 years 5 months, eight months after admission, she was discharged from hospital and was free from pica. She remained on iron by mouth and had intermittent courses of chelating therapy, because her blood lead level was still above normal limits. Her haemoglobin did not rise above 10.3 g/100 ml (70 per cent). At the time of final follow-up, when she was 3 years old, she remained free from pica, her blood lead was 77 $\mu\text{g}/100\text{ ml}$ and haemoglobin 11.3 g/100 ml (76 per cent). She still had no speech and there seemed no doubt that she was a brain-damaged child.

Diagnosis

Lead encephalopathy following pica. Permanent brain damage sustained.

CASE HISTORY OF ALLAN B.

Date of birth: 16 August 1961

Age when referred for investigation: 2 years 9 months

Length of follow-up: 5 years 3 months

General background

Family background

The mother was 33 years and the father 37 years at Allan's birth. The mother had had a poor education, missing most of her time at school because of illness. When she left school she worked in a factory and then as an assistant

at an orphanage. Following her marriage she was a full-time domestic and, finally, a shop assistant. The father was brought up in a children's home following desertion by his father, and attended a boarding school. He left school, went into the army, and, following demobilization, he had several jobs with long periods of unemployment between. Finally, he worked on the railway but, when Allan was 8 years, was dismissed following a petty crime. He was then faced with unemployment and a large fine to pay. The father favoured the seventh child in the family but always disliked Allan.

Siblings

There were eight children in this family, Allan being the eighth. The first five children attended boarding schools for the maladjusted, or the educationally subnormal (ESN) or physically handicapped. The causes of these various disabilities were not known. The oldest girl had left boarding school and married; the second, a boy, had entered the navy; the next three were still at school. The last three children attended day school and lived at home, but the sixth child was epileptic and ESN, and neither of the last two children, including Allan, was doing well at school.

Housing and finance

The family was moved to a council house from condemned property just before Allan was born, but this was not large enough for the entire family. At the time of the final follow-up, when Allan was 8 years old, they faced eviction due to rent arrears. The mother had found it necessary to work full-time for most of Allan's childhood. The financial position had always been difficult due to paternal unemployment.

Subjective assessment of parental competence

There was constant marital disharmony and the mother was overwhelmed by the problems of her children and the inadequate support from her husband. She had chronic physical complaints such as backache which had been investigated and nothing abnormal found. She was subject to recurrent episodes of vomiting, when she lost a lot of weight—a gastric ulcer had been diagnosed. She had a psychiatric illness when Allan was 7 years and took an overdose of sleeping tablets, but refused psychiatric hospital admission. The father suffered from a gastric ulcer and had several accidents, including a compound fracture of the knee. The mother was a poor witness and had a poor recollection of her children's problems. She did not believe in discipline and the children were never smacked. However, they were subjected to unnecessary hardships such as her insistence that they prepared for bed in the dark.

Contact with the neighbourhood

This was a poorly integrated family who made little contact with the surrounding environment, but was well known to various social agencies.

Personal history*Birth and early development*

The pregnancy was normal apart from an accident at term when a door fell on the mother. Labour induced soon after this and she had a full-term normal delivery, the child weighing 2.3 kg (more than 2 SDs below the mean). His milestones were normal: he sat alone at 6 months, stood holding on at 12 months and walked alone at 16 months. His first words were at 8 months and he had several clear words at 12 months. He managed a cup at 9 months and a spoon at 18 months. He was bottle-fed by the clock and did not accept a dummy. He was no particular problem at night. Toilet training began at the age of 4 months and it was completed by 2 years. His mother described her attitude as strict. Speech development was normal.

Childhood separation

Because his mother was out to work full-time when he was young, his older sister brought him up and looked after him consistently. He was placed in a day nursery at 2 years and attended until the age of 5 years, when he entered infant school. His mother saw him every day during his childhood and there were no enforced periods of separation, apart from hospital admissions. Allan was rarely left unsupervised.

Accidents and illnesses

At 2 years 9 months Allan was admitted to hospital after eating a large number of aspirins. At 6 years he fell out of a window and fractured his shoulder; in the same year he fell out of a tree, fracturing his arm, and at 7 years he was involved in a road traffic accident, fracturing his skull. He had numerous minor illnesses—diarrhoea, vomiting, sore throats and high temperatures—and he complained of persistent headache following his skull fracture. He had his tonsils and adenoids removed at 5 years.

Feeding problems and iron deficiency anaemia

Solids were started at 10 months and he was still having a bottle once a day at 2 years 9 months. He was seen at 3 months in the paediatric out-patient clinic when his diet was thought to be deficient of protein and he also had bronchitis. At 5 months he was found to have a mild iron deficiency anaemia. His haemoglobin was 10.4 g/100 ml (71 per cent) and he was admitted to hospital for treatment of this and a recurrence of bronchitis. At 8 months he was still anaemic and the diet remained poor. At 14 months he was admitted to hospital for investigation of vomiting and for treatment of a further respiratory infection. His haemoglobin was then 10.6 g/100 ml (73 per cent) and his weight was between percentiles 10 and 25. He was a miserable baby, constantly crying as if hungry and yet refused food when it was offered. The

recurrent vomiting and food refusal settled in hospital without specific treatment. Oral iron had been prescribed for his mild anaemia for most of his life but it was thought unlikely that he had received much of this medication from his mother.

At 2 years 2 months his haemoglobin was 11.9 g/100 ml (81 per cent). Food refusal became severe between 2 years 6 months and 2 years 9 months. Between 4 and 8 years of age he had a very good appetite and was fond of protein-containing food. At this time he drank large quantities of water and this was still occurring at the time of final follow-up.

Pica

No clear history of pica could be obtained because the older sibling who cared for him was no longer in touch with the family. However, at 2 years 9 months when he was admitted to hospital following ingestion of aspirin tablets he was noted to have pica and would chew the cot, the window-sills in the ward and his toys. On direct questioning, his mother admitted he ate his toys at home and picked holes in the plaster of the wall. For several months before admission he had been unusually sleepy.

On admission to hospital

He was 2 years 9 months when admitted to hospital, and remained there for three months. He was noted on admission to be pale, miserable and apathetic.

Investigations and treatment

His blood lead level was 56 μ g/100 ml and his haemoglobin was 10.4 g/100 ml (71 per cent), and reticulocytes 2.2 per cent. No basophilic stippling was seen. X-ray of the abdomen revealed no abnormalities and x-ray of the long bones gave no convincing evidence of lead poisoning. His weight was between percentiles 50 and 75. There were no coproporphyrins in the urine and he had no abnormal aminoaciduria.

He was treated with penicillamine 150 mg b.d., and this was given intermittently for a total of 4 months. During this time his blood lead level fell to 38 μ g/100 ml. His haemoglobin rose to 11.9 g/100 ml (81 per cent) with iron therapy during the period of three months in hospital, and yet he continued to have pica. Blood lead levels of all the family apart from Allan were tested and were found to be at the upper limit of normal.

Progress after discharge from hospital

The family were helped by numerous social agencies in addition to the hospital personnel during the following years. His pica continued for a year after discharge from hospital but at 4 years of age he improved. This coincided with full-time attendance at a nursery school. He was a sensitive child, becoming distressed and crying whenever he was reprimanded, and tended to

be more miserable than his siblings. He was occasionally naughty but no more difficult to control than his older brothers. He sucked metal guns and pencils whenever he was anxious and he vomited occasionally for no apparent reason.

At 8 years his height was between percentiles 25 and 50, his weight was between percentiles 50 and 75, his blood lead level was 26 $\mu\text{g}/100\text{ ml}$ and his haemoglobin was 13.1 g/100 ml (89 per cent).

Allan B.

Aged 8 years.

Personality profile

Normal intelligence; no pica when profile constructed.

Aggressive					Submissive
Noisy					Quiet
Attention seeking					Isolated
Disobedience					Passivity
Over-activity					Apathy
Destructive					Not destructive
Rigidity					Adaptability
Independence					Timidity
Irritability					Affability
Obstinacy					Amenability

Psychological assessment

Using the Wechsler Intelligence Scale for Children, at 8 years he had a full-scale IQ of 116, but educational tests showed that his academic attainments were retarded by approximately 1 year.

Diagnosis

Pica in a socially deprived boy of normal intelligence.

CASE HISTORY OF HOWARD C.

Date of birth: 19 November 1963

Age when referred for investigation: 3 years 3 months

Length of follow-up: 2 years 3 months

General background*Family background*

The mother was 24 years when Howard was born. She was rhesus negative but this gave rise to no trouble with her pregnancies. She had asthma when she was a child and went to an open air school. She was a clerical worker before her marriage but had not worked since then. The father was 29 years at Howard's birth, in good health and worked as a bus conductor. All the grandparents were alive and well. A first cousin aged 5 years 6 months at the time of referral was retarded in speech.

Siblings

Richard was 10 years, Simon 8 years and John, born in 1966, a few months old at the time of the initial referral. Richard and Simon attended primary school and appeared to be bright. John also developed normally.

Housing and finance

The family were housed on a council estate, having a terraced house with a garden, bathroom and toilet. Howard shared a bedroom with his older brothers. Finances were difficult because the father had to change his work from a plasterer to a bus conductor so that he could work shifts in order to help look after Howard.

Subjective assessment of parental competence

Both parents appeared to be realistic in their handling of the children, realizing that each had different needs. They found the eldest two boys quiet, conscientious, sensitive and easy to manage. They described themselves as 'happy-go-lucky' parents, not insisting on discipline and never smacking their children. One's impression of this family was that they would cope well and remain a happy united family, provided serious stress did not arise.

Contact with the neighbourhood

This was a friendly family who had made good contact with their neighbours, but Howard's difficult behaviour had been the subject of controversy and had caused some alienation.

Personal history*Birth and early development*

The pregnancy was normal and planned. The delivery was normal in hospital at 39 weeks, the birth weight being 3.6 kg (1-2 SDs above the mean). He was breast-fed for 1 month, but vomiting started from the first day and continued to be a major problem. His milestones were normal: he smiled early, sat at 6 months and walked at 14 months. He was slow to become clean and dry because of a prolonged negativistic phase that lasted from the age of 1 to 3 years. His speech development was delayed.

Childhood separations

He was admitted to an isolation hospital with gastroenteritis at 18 months for three weeks. He was also separated from his mother for 12 days on the birth of the fourth child, but saw his mother regularly. He was admitted to hospital for the removal of adenoids at 3 years 6 months and for the removal of tonsils at 5 years.

Behavioural problems

At 1 year of age his parents thought his behaviour was strange; he had become irritable and had temper tantrums. Since that time he developed into a difficult negativistic over-active child, this behaviour much accentuated by the arrival of the younger baby when Howard was 3 years old. He then became absorbed in the baby's activities, regressing and showing a mixture of jealousy and affection. He mimicked the baby, snatched the bottle and insisted on drinking from it. At this stage his negativism for toilet training disappeared and he became toilet trained by copying the potting regimen of the baby. His constant activity and lack of inhibition with strangers was a problem. He slept badly and would disturb the family in the night. He would run into the road and had no danger sense. He had temper tantrums almost every day over trivialities and was indifferent to scolding. He was not tolerated by his peer group as he would join in play but become domineering.

Between the ages of 3 and 4 years his personality changed to that of a very sensitive child, crying unduly if reprimanded and clinging to his mother. He needed constant reassurance that she loved him and that he was being a good boy. He had also become less over-active and showed shyness when meeting strange adults. He stopped running into the road and became unduly frightened of traffic. He was still over-active at night.

Pica

Mouthing of objects was noted at 9–12 months, but this gradually became worse until at 2 years 6 months he was eating dirt, coal and stones. He tried to get to the pavement to eat the faeces of dogs and any dirt he could find in the road. When in the house he would chew carpets and underfelt, chew and swallow buttons from his clothes and also chew pencils. At 2 years 6 months he found a bottle of bleach, drank it and, despite the corrosive effect on his lips, asked for more.

His pica gradually improved and ceased completely between the ages of 3 and 4 years. This coincided with an improvement in his behaviour, admission to the nursery class of the local infant school at the age of 3 years 6 months and the onset of speech therapy.

Feeding problems

Vomiting started from the first day of life and was so severe and persistent in infancy that pyloric stenosis was suspected. He continued to vomit frequently during childhood. Solids were introduced at 6 months, but he refused to chew and at 3 years he was still swallowing food whole, often vomiting immediately after meals or when in bed at night. He was not allowed to eat with the family at mealtimes because he would throw the food across the table, turn his plate upside down or stand on the table. Whenever distressed he regressed and wanted milk from the baby's bottle, and he insisted on a bottle in bed at night. He always had a large appetite, even when his pica was at its worst.

From the age of 3 to 5 years his eating habits gradually improved and the vomiting lessened until he was able to join in school meals in the nursery class with no difficulty.

Retarded speech development

His first words were at 3 years, and at 3 years 3 months, when seen by the speech therapist, he was noted to be echolalic and dyslalic. He was noted to have comprehension of speech far in advance of his use of speech, which was below the level of his other attainments. His hearing had been tested and found to be normal. He responded well to the speech therapy that he received from 3 years 6 months and, although he remained dyslalic, his voice soft and speech difficult to understand, at 4 years he began composing short phrases and then sentences of about 6 words.

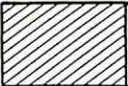
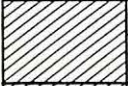
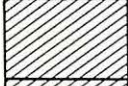
On examination

At 2 years 2 months and 3 years 3 months his weight was between percentiles 90 and 97. His height at 3 years 3 months was between percentiles 75 and 90. He was a normal-looking, attractive boy with no physical abnormalities. His blood lead level (at 3 years 3 months) was 30 µg/100 ml.

Howard C.
Aged 3 years.

Personality profile

Behaviour disturbance; pica present

Aggressive					Submissive
Noisy					Quiet
Attention seeking					Isolated
Disobedience					Passivity
Over-activity					Apathy
Destructive					Not destructive
Rigidity					Adaptability
Independence					Timidity
Irritability					Affability
Obstinacy					Amenability

Psychological assessment

When he was 3 years 3 months, incomplete results were obtained on the Stanford-Binet Intelligence Scale (L-M). He performed some non-verbal items up to the 3 years 6 months level and some verbal items at the 2 year level. It was not easy to hold his attention or to demonstrate items to him. It was difficult for him to communicate and only a few single words were intelligible. His performance on non-verbal items was good for his age, but his use of

speech was retarded, at an approximate 2 year level. These and other results indicated a specific backwardness in speech, which was due to an executive dysphasia and dyslalia.

A further psychological assessment at 4 years 3 months revealed a much more co-operative boy than in the year previously. On the Stanford-Binet Intelligence Scale (L-M) he had a mental age of 3 years 8 months (IQ 85). He was then functioning in the dull normal range and, while his speech was still unclear, his verbal abilities were in line with his non-verbal attainments, and there was no longer any evidence of a specific language retardation.

Progress

At 4 years 11 months his haemoglobin was 11.1 g/100 ml (76 per cent). He had received no iron therapy throughout his childhood. He was admitted to school full-time at 5 years and was finally seen at 5 years 6 months. He was causing no problem in school and was doing well. His drawings appeared adequate for a 5-year-old. His mother said he was no longer any problem in the home and she was not worried about him. When interviewed with his mother, Howard seemed a little shy but answered all questions put to him. His speech still seemed a little indistinct. His height and weight were both between percentiles 90 and 97.

The family then moved out of the area and no further follow-up was possible.

Diagnosis

Developmental speech disorder and pica with behavioural and feeding problems.

CASE HISTORY OF JOHN C.

Date of birth: 13 July 1963

Age when referred for investigation: 5 years 0 months

Length of follow-up: 1 year 3 months

General background

Family background

John's father was 38 years at his birth and worked as an unskilled factory labourer, but was periodically out of work. He suffered an eye injury as a boy and had only unilateral vision. He also suffered from chronic bronchitis. He had had very little education, in Canada. The mother was 41 years at his birth; she missed most of her schooling, in Ireland, and she worked on a farm before her marriage. She had four children in eight years and was sterilized after the fourth. All her children were born by caesarian section. Blood lead levels of

both parents were normal at the time when John was lead poisoned. An uncle had had pica for cigarette boxes.

Siblings

The oldest boy, aged 8 years at the time of referral, was found to have an iron deficiency anaemia, haemoglobin 6.6 g/100 ml (45 per cent), but no pica. There was a sister aged 6 years, and a brother aged 5 months who both had normal haemoglobin levels. The blood lead levels of the siblings were normal.

Housing and finance

Housing and finance had always been unsatisfactory. The family were housed in a damp three-roomed basement flat in a house due for demolition. There was no bathroom and the family slept in one bedroom. The flat was fairly clean but poorly furnished and decorated. There was a large garden full of rubbish which John used to chew. The family moved to better accommodation when John was 5 years 6 months, but this was still poor.

Their financial state was precarious. The father smoked and drank a great deal and there was little money for the rest of the family.

Religion

This was a Roman Catholic family with a superstitious kind of faith based on fear.

Subjective assessment of parental competence

The mother seemed capable, genuinely fond of all her children and anxious to help each one, but hindered by lack of money, knowledge and paternal support. The father was shiftless and irresponsible, more anxious about his bronchitis than his children's difficulties. There appeared to be little disagreement over the management of the children.

Contact with the neighbourhood

This was an isolated family, although both parents had been in Britain for about 16 years. There was no contact with the neighbours or the mother's relatives who lived nearby. The children were taken to the park on occasions, but otherwise played on their own at home. Holidays were usually provided in Ireland by the maternal grandmother. Contact with the local health clinic was fairly regular but the mother had received little help for John.

Personal history

Birth and early development

John was born by planned caesarian section because of a small maternal pelvis. The birth weight was 3.2 kg (mean to 1 SD below the mean) and there were no neonatal problems. His motor milestones were delayed and he did not

walk until he was almost 2 years, but his first words were at 1 year. There were no feeding problems in infancy. He fed well by the bottle on a 4–6-hourly basis and was feeding himself by 2 years. He was not given a dummy. Solids were started at 15 months and introduced with no difficulty. He had a good appetite until the age of 3 years. Toilet training was completed at 18 months and his mother described her attitude as strict. He slept well, never used a comfort blanket and rarely sucked his thumb or fingers.

Childhood separation

His mother had cared for him consistently since birth. He had not attended a day nursery or school, and the only mother–child separation that had occurred was for 13 days during the birth of the fourth child, when he was 4 years 6 months. There appeared to be no adverse reaction to this. He was rarely left unsupervised.

Pica

Pica started when he was about 3 years. No precipitating factor can be remembered. He started by chewing his blanket in bed at night and this gradually became so severe that there were no blankets left for his bed. He then chewed the carpet and underfelt, ate chalk, crayons and pencils, and chewed at his own clothing. He also chewed furniture covers and wooden furniture, newspapers, towels, toilet paper and painted toys. When in the garden he would eat the earth and twigs from under the tree, and would also gnaw at the bark. He would follow his mother around as she swept the floor waiting to pick up the dust to eat. He chewed books and cardboard. The crisis came when he chewed the collar of an army greatcoat one night and, following this, his mother made him sleep in a large Polythene bag. Despite the heterogeneity of the substances ingested, his favourites were blankets and wood. He indulged in pica many times a day and when told to stop resumed within a few minutes; he showed distress when objects were taken away from him and would only cease when actively removed from a fixed object. His pica was related to nothing in particular, but it was noted to stop immediately on admission to hospital.

His parents had responded to his pica by smacking, telling him that he would die, and by trying to give him extra love and attention. Diverting his attention was found to be useless. His mother had always felt worried about the symptom, having been told that it would lead to heart failure. She had never regarded this as naughtiness but felt that it was a habit he could not break.

Feeding problems

His appetite waned from 3 years and a severe anorexia occurred at 4 years 11 months. This coincided with an exacerbation of his pica for wood. He would often refuse breakfast and eat only a boiled egg or cereal at lunchtime. For his evening meal he would rarely eat meat and vegetables, but would have a cup of tea before bedtime.

Behavioural changes

His parents noticed that he had become quiet and withdrawn but otherwise he showed no other symptoms of psychological disturbance.

On admission to hospital

He was aged 5 years when admitted to hospital, and his weight and height were between percentiles 3 and 10. He appeared pale but otherwise normal.

Investigations and treatment

His haemoglobin was 5.6 g/100 ml (37 per cent). He received a blood transfusion seven days after admission. On discharge six weeks later his haemoglobin was 11.6 g/100 ml (79 per cent). His blood lead level on admission to hospital was 90 $\mu\text{g}/100\text{ ml}$. X-rays of the knee and abdomen showed no lead lines and no radio-opaque material was seen in the bowel.

He was treated with penicillamine, 300 mg b.d. for a week and then 150 mg b.d. for five weeks. Pyridoxine was also given. On discharge his blood lead level had fallen to 48 $\mu\text{g}/100\text{ ml}$.

Examination of the bark of a tree that he had bitten revealed insignificant quantities of lead (*Figure 12*). Despite investigation of the house and contents and analysis of toys chewed, no major source of lead was found.

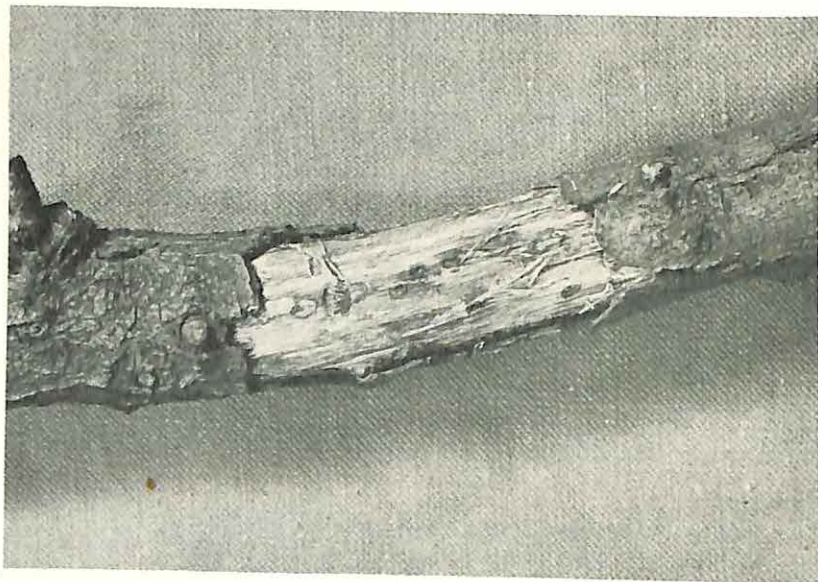


Figure 12. Piece of stick, showing chewed bark. Lead content was 0.2 per cent (John C., aged 5 years)

John C.
Aged 4 years.

Personality profile

Deprived child; pica present.

Aggressive					Submissive
Noisy					Quiet
Attention seeking					Isolated
Disobedience					Passivity
Over-activity					Apathy
Destructive					Not destructive
Rigidity					Adaptability
Independence					Timidity
Irritability					Affability
Obstinacy					Amenability

Behaviour

No pica was observed following admission to hospital. He behaved as an entirely normal, friendly, obedient child who enjoyed life in a hospital ward. His appetite suddenly increased until he was eating enormous meals. He admitted he was happy in the ward and did not want to go home.

Psychological assessment

Using the Wechsler Intelligence Scale for Children he had a full-scale IQ of 93, a verbal IQ of 91 and a performance IQ of 96.

Progress after discharge from hospital

He was discharged home after six weeks in hospital and, because he was 5 years old, started school. He was followed up for 15 months. He remained on oral iron therapy for three months after discharge, when his haemoglobin was 13.1 g/100 ml (90 per cent).

He attended school regularly and kept in good physical health. When distressed he chewed pencils and ballpoint pens, the corner of his shirt, pillowcase or tie. He had not been eating wood. If he was found chewing objects, he was smacked by his mother. His appetite was much improved and he ate school dinners each day. He remained an isolated type of child, created no major problems at school and, although progress at school appeared to be slow, it was probably the norm for his cultural background. The youngest child was 18 months old at the time of final follow-up and had never had pica.

At 6 years John's blood lead level was 44 $\mu\text{g}/100\text{ ml}$ and his haemoglobin was 11.1 g/100 ml (76 per cent). His height was then between percentiles 10 and 25 and his weight was between percentiles 3 and 10.

Diagnosis

Pica, anaemia and lead poisoning in a socially deprived boy of normal intelligence.

CASE HISTORY OF MANDY D.

Date of birth: 15 May 1963

Age when referred for investigation: 4 years 0 months

Length of follow-up: 2 years 4 months

General background*Family background*

Mandy's mother was 43 years and her father 41 years at her birth. The mother was a GPO telephonist before her marriage and since then did occasional evening work. The father worked as a milkman until he developed an anxiety state after being attacked on his rounds and then became a cabinet maker. He had had pica for paper during his early childhood. There was severe marital disharmony in this family, accentuated by the many problems that the children created.

Siblings

The first child was a girl aged 17 years at the time of referral. She had an illegitimate child and Mandy's pica started in the later stages of her sister's

pregnancy. The sister then left home to live with a boy to whom she became engaged. While her baby stayed with them he was battered on several occasions and developed bilateral subdural haematomata. A court case followed; the whole family were placed under police supervision and the battered child was placed with Mandy's mother.

The second child, a boy of 16 years, lived at home but had disagreements with both parents. At approximately 3 years of age he had chewed wallpaper and his appetite had been poor; medical advice had been sought and the parents were told to punish him. Subsequently he truanted from school and was deemed maladjusted.

The third child, a boy of above average intelligence and one year older than Mandy, had attended hospital because of pica for coloured comic paper at the age of 3 years. This pica had lasted a year. His appetite was good before pica started but then became poor, with food fads. At 3 years 6 months he developed bronchitis which was chronic throughout his childhood.

Mandy was the fourth and last child of these parents, Peter, the illegitimate child of the oldest girl, being added later to the family unit. Sibling rivalry was obvious between the three younger children, with much aggression and spitefulness to each other.

Housing and finance

The family lived in a terraced house which had a bathroom, toilet and garden. The house was in a state of general disrepair and there was a poor standard of cleanliness. The financial position was always difficult because of the father's low wages, but had been strained even more by the necessity to accept Peter as a member of the family.

Subjective assessment of parental competence

The father refused to be interviewed and terminated the follow-up of his child, so no direct assessment of his role in the family could be made. From descriptions of father/child interaction there seemed to be a deep attachment between the father and Mandy, of which she periodically took advantage and regressed in company when her father was present. He was said to have an aggressive personality and disliked the medical profession, feeling that they were incompetent to solve his family's difficulties. The mother was a kindly but ineffectual woman who had little control over her children and felt overwhelmed by their many problems and by the lack of help and understanding from her husband. She felt that discipline, in particular smacking, was not necessary in the upbringing of children.

Contact with the neighbourhood

Contact with the neighbourhood was fairly good through their local Roman Catholic church.

Personal history*Birth and early development*

The pregnancy and delivery at full term were normal. Mandy's birth weight was 3.7 kg (mean to 1 SD above the mean). There were no neonatal problems and milestones were passed at the usual time apart from a delay in walking; she was sitting unsupported at 5 months, standing supported at 13 months but was slow to walk alone at 23 months. She managed a cup and spoon at just over 12 months. She babbled early, began to form meaningful syllables at 6 months and speech development was normal. She was bottle-fed on demand, breast-feeding not being successful because of mastitis. She refused a dummy. Solids were started at 3 months and there were no early feeding problems. She always had a normal appetite until pica began and there were no food fads. Toilet training was started at 1 year and by 2 years she was clean and dry, day and night.

Childhood separations

Mandy had been cared for consistently by her mother apart from a period of three months in hospital at 4 years. She started at the local infant school at 5 years.

Pica

Mandy developed whooping cough at 3 years 11 months at a time of intense sibling rivalry with her older brothers and with her sister who was in the late stages of pregnancy. Pica began during this period of emotional disturbance and physical illness. She had enjoyed chewing gum before her pica started and she was constantly chewing this when her whooping cough began.

She started by eating linen handkerchiefs, then paper handkerchiefs and comics. She became apathetic, developed severe anorexia, and often was coughing and vomiting.

Her parents reprimanded her verbally but did not smack her. They were concerned about this habit because they thought the newsprint contained poison and that she might catch worms. They regarded this as naughtiness rather than an illness and tried to prevent it by threatening her with punishment and withdrawal of all privileges.

After a month of illness at home she was admitted to hospital. Her pica was then severe. She ate newsprint in any form, writing paper and paper handkerchiefs. She would do this frequently each day, would stop when she was told but immediately resumed when she found different paper. Occasionally she would stop if her attention was distracted to something else. Her pica was not thought to be related to boredom or hunger.

Sleeping problems

She had always been a bad sleeper, restless in the night and, from early

childhood, frightened to go to bed. There were no nightmares. She used a comfort blanket until 3 years of age.

Illnesses

Mandy had numerous minor somatic complaints from early childhood, of abdominal pain, headaches and vomiting which was occasionally self-induced. She used complaints of headache or abdominal pain to avoid unpleasant situations.

Feeding problems

Food refusal did not start until her pica was severe. When she was admitted to hospital her appetite was non-existent, particularly in the presence of her parents, but she began to eat in the company of other children in the ward. As her pica improved, so did her appetite and from 4 years 6 months was entirely normal.

Behaviour problems

Abnormal fears of the dark, animals and water had gradually developed from early childhood and made her management difficult. She was an affectionate child but had a severe temper and would tease; for these reasons she was not popular with her peers. She bit her nails almost constantly, masturbated occasionally and would induce regurgitation after an upset.

On admission to hospital

She was 4 years old when admitted to hospital. She appeared severely ill and pale, with total food refusal, coughing, vomiting, abdominal pain, misery and lethargy.

Investigations

Her weight was between percentiles 25 and 50 and her height was between percentiles 75 and 90. Her haemoglobin was 6.7 g/100 ml (46 per cent) and the blood film showed hypochromia. A serum iron was 15 µg/100 ml, total iron-binding capacity being 160 µg/100 ml. Her blood lead level was 31 µg/100 ml and x-ray of the long bones showed no lines of increased density. Examination of her urine revealed an infection but a subsequent intravenous pyelogram and micturating cystogram were normal. From the history and symptoms, a diagnosis of probable whooping cough was made but could not be confirmed.

Progress in hospital

She was treated with an iron preparation by mouth, urinary antibiotics and cough suppressants. As her general condition improved and she became more alert, she made use of somatic complaints to seek attention and was seen to make herself sick on many occasions. She admitted she was happy in hospital

and did not want to go home. She later became over-active and demanding of affection. Food refusal was noted to be worse when her mother was present and her behaviour was negativistic and destructive when her father visited. Her pica was initially severe in hospital and she used devious methods to obtain paper to eat. Her haemoglobin rose rapidly to 9.1 g/100 ml (62 per cent) and later to 13.0 g/100 ml (88 per cent).

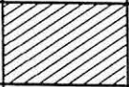
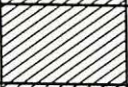
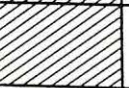
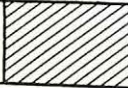
During the latter part of her admission she slowly became a happier, better adjusted child and began to be able to share attention and affection. Her pica

Mandy D.

Aged 6 years.

Personality profile

Neurotic behaviour disturbance. No pica when profile constructed.

Aggressive					Submissive
Noisy					Quiet
Attention seeking					Isolated
Disobedience					Passivity
Over-activity					Apathy
Destructive					Not destructive
Rigidity					Adaptability
Independence					Timidity
Irritability					Affability
Obstinacy					Amenability

improved during the last two weeks of her admission and on discharge was no longer a major problem.

She was discharged from hospital three months after admission with a diagnosis of behaviour disorder, pica and resolved pertussis.

Psychological assessment

Although no intelligence test was performed, school reports suggested that she was a child of at least average intelligence.

Progress after discharge from hospital

During the following two years four months she remained a neurotic, sensitive child inclined to be miserable and attention seeking. She resented the presence of Peter, the youngest child in the house, and was aggressive towards him. Her pica occasionally returned at a time of family crisis, when she would eat wallpaper and newsprint. She received frequent iron tonics as a panacea for her many neurotic complaints. At the age of 6 years 4 months her weight remained between percentiles 10 and 25, and her height between percentiles 75 and 90.

Diagnosis

Pica for paper in a child of average intelligence, with a severe neurotic behaviour disturbance. Family disharmony.

CASE HISTORY OF JAMES H.

Date of birth: 7 June 1961

Age when referred for investigation: 4 years 6 months

Length of follow up: 3 years 9 months

General background

Family background

The child was the illegitimate offspring of an Irish mother and Indian father. Both parents were healthy. There were no known siblings.

Personal history

Birth and early development

The pregnancy and delivery at term were normal and there were no problems during the neonatal period. The birth weight was 2.8 kg (1–2 SDs below the mean). At 6 weeks James was placed in a residential nursery where he remained until admission to a subnormality hospital at the age of 4 years 6 months. Repeated episodes of eye rolling started at 6 weeks. At 8 months he was thought not to respond to sound and began to bang his head and scream

for no apparent reason. At this early stage his development was retarded but there was no evidence of deafness. At 14 months he could sit only with support and would not follow a light. At 18 months he sat unsupported. He stood unsupported at 2 years 6 months and walked alone at 3 years. At this stage he was doubly incontinent and had no speech. He showed a general dislike of and an inability to chew food. There had never been any sleeping problems.

Childhood separations and periods of loneliness

Because he was a difficult child to supervise and there was a shortage of staff, he was left alone in his cot for many hours at a time.

Pica

He began to chew the woodwork of his cot at 18 months. When he could walk at 3 years he began to chew the window-sills. His pica was so persistent that considerable damage to the woodwork resulted and this was the main reason for requesting hospital admission.

Behavioural problems

From early childhood he was a solitary and manneristic child, resenting any interference. As his pica became worse, his behaviour deteriorated; he became aggressive, noisy, showed visual avoidance and inflicted self-injury.

On admission to hospital

When admitted to hospital at 4 years 6 months he was an attractive, apparently physically fit child whose height was between percentiles 3 and 10 and his weight between percentiles 10 and 25. His head circumference was 2-3 SDs below the mean for his age and sex. No neurological abnormalities were detected.

Behaviour in hospital

He showed outbursts of apparent anger and frustration, avoided contact with people and put all objects, except food, into his mouth; he showed little interest in food. He had to be spoon-fed and was doubly incontinent. Chewing of painted wood in the ward persisted (*Figure 13*) despite attempts by the nursing staff to discourage this. One sample of wood chewed by James contained 11.6 per cent of lead.

Psychological assessment

He was first assessed in the residential nursery when he was 18 months old. His mental age was then approximately 6 months. At 4 years 6 months his developmental level was 4-8 months with relatively advanced locomotor ability, this being 15-24 months (Griffiths Scale of Mental Development and

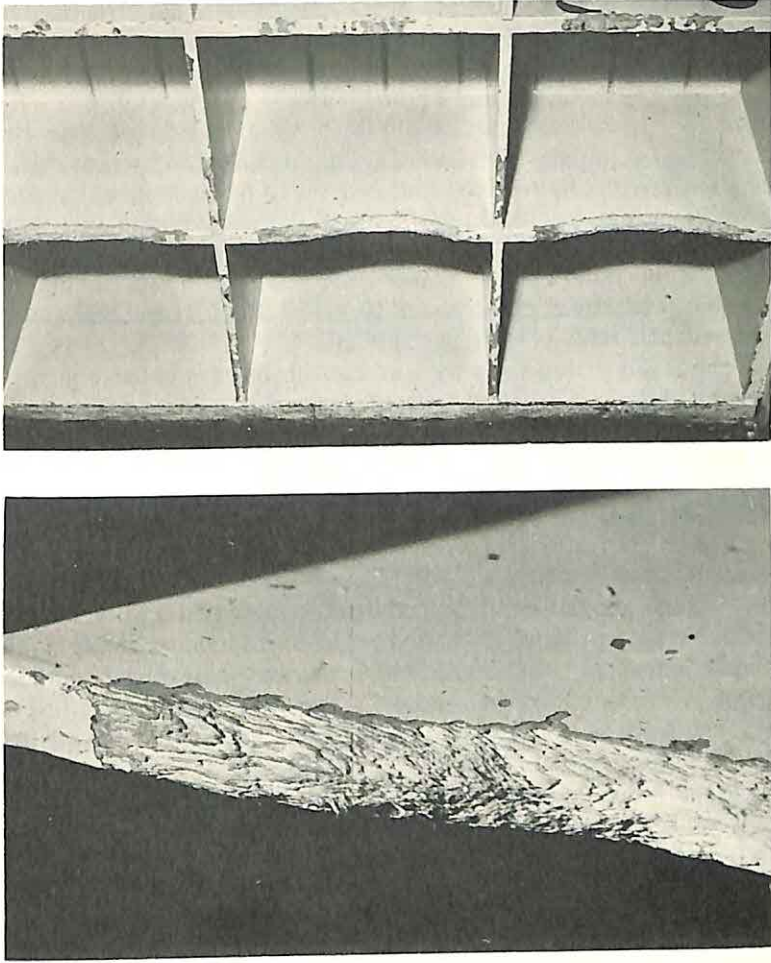


Figure 13. Chewed book case. Lead content was 11.6 per cent (James H., aged 6 years)

Piaget sensorimotor scale of development). Eleven months after admission to hospital (aged 5 years 5 months) further psychological assessment revealed that his sensorimotor abilities had progressed to Piaget stage IV-V (mental age of approximately 12 months). His locomotor ability remained far in advance of his other attainments.

Investigations

His blood lead level on admission was found to be 155 $\mu\text{g}/100\text{ ml}$. X-ray examination of the abdomen showed multiple radio-opaque bodies and x-ray of

the wrist revealed increased density of the metaphyseal line. His haemoglobin level was 10.2 g/100 ml (69 per cent) and the red cells showed basophilic stippling.

Treatment

He was treated initially with bowel wash-outs and iron therapy; during the following ten months he received four courses of penicillamine, but the blood lead level did not fall below 93 $\mu\text{g}/100\text{ ml}$, eventually rising to 166 $\mu\text{g}/100\text{ ml}$. X-ray examination of his abdomen, during this period, showed a rapid reappearance of radio-opaque bodies following the bowel wash-outs. His haemoglobin level remained at about 10 g/100 ml (67 per cent) and the red cells showed persistent basophilic stippling.

Throughout this period there were no convulsions or abnormal neurological signs but his disturbed behaviour persisted. Further treatment was then given, consisting of calcium EDTA and oral penicillamine. Daily lead estimations on single samples of urine were done during this period of treatment and concentrations reaching a peak of 11,000 $\mu\text{g}/\text{l}$ were found. While he was receiving both chelating agents, his blood lead level slowly improved.

Progress while in hospital

Following the above treatment, his appetite increased and he began to eat solid food. He became more active and began to respond to simple commands. He sought affection, was more amenable and had fewer outbursts of screaming. An EEG at this time showed a generalized increase in fast activity with infrequent paroxysmal bursts of spike and wave activity lasting from one to three seconds.

During the latter period of treatment his behaviour was observed by a psychologist. It had previously been noted that he had often carried a painted toy to chew, but on testing by random presentation of painted and unpainted blocks he showed no preference for the painted ones. When encouraged to carry a block in his hand, he mouthed it often and made considerably fewer attempts to chew the paint on the window-sill.

Fifteen months after admission he started to attend the hospital special school part-time. Seventeen months after admission, at the age of 5 years 11 months, he had a succession of grand mal attacks lasting one hour. An EEG taken after this episode was similar to the previous recording and the blood lead level the following day was 74 $\mu\text{g}/100\text{ ml}$. There was no history of preceding infection. He started on long-term phenytoin medication and had no further fits.

His progress was slow. He remained doubly incontinent, had no speech and needed help to walk up and down stairs. He was still chewing any painted object within reach. His pica was noted to be worse during the afternoon, and related to boredom for he attended school in the mornings only. At 6 years 9

James H.
Aged 7 years.

Personality profile

Mentally retarded. No pica when profile constructed.

Aggressive					Submissive
Noisy					Quiet
Attention seeking					Isolated
Disobedience					Passivity
Over-activity					Apathy
Destructive					Not destructive
Rigidity					Adaptability
Independence					Timidity
Irritability					Affability
Obstinacy					Amenability

months he was transferred from a ward for very handicapped children to a ward for more active boys, most of whom were older than himself, and he started to attend school full-time.

At 7 years his play gradually became more sophisticated, he vocalized constantly but was still over-active and distractible. Mouthing and chewing became less as he developed an interest in knocking toys together or on different surfaces and putting toys in a cart to pull around.

Around 8 years he had developed a little speech, was over-active and

preoccupied by banging and touching toys. Psychological assessment at 8 years revealed a developmental age of 12–18 months on the Piaget sensorimotor scale, with locomotor development at 36 months. He still obtained no score on the Stanford–Binet Intelligence Scale. His blood lead level was 59 $\mu\text{g}/100\text{ ml}$ and his haemoglobin was 12.4 g/100 ml (85 per cent). His height and weight were both below the third percentile. He had no pica when occupied and only resorted to chewing painted wood when bored. He was easily distracted from this and pica no longer was a problem in management. He had developed a normal appetite, could chew adequately and feed himself; he recognized staff members and his teacher, and was more affectionate and amenable. Throughout his hospital stay he had never had a haemoglobin level less than 10.3 g/100 ml (69 per cent) or more than 12.4 g/100 ml (85 per cent) despite intermittent oral iron therapy. At the time his pica ceased to be a problem the striking changes were the improvement in his play, his increased ability to relate to adults and the beginning of speech development.

Diagnosis

Illegitimate, severely subnormal child, with early institutionalization, who developed selective pica for painted wood resulting in lead poisoning.

CASE HISTORY OF ROBERT H.

Date of birth: 28 July 1965

Age when referred for investigation: 1 week

Under hospital review all his life.

Age at final follow-up: 4 years 4 months

General background

Family background

Robert's mother was aged 35 years and his father 36 years at his birth. Both had had excellent grammar school education. The mother became a psychiatric social worker which she gave up when she started having her family. The father was a PhD graduate in physics and was a university lecturer.

Siblings

There were four children in the family, Robert being the third. The first two, born in 1962 and 1963 respectively, were normal and attended primary school. The last child, born in June 1968, has developed normally.

Housing and finance

There were no problems with respect to housing and finance. The family had a pleasant detached house in a good residential area.

Subjective assessment of parental competence

The mother appeared well able to care for her children but always found Robert difficult to manage. Although she was fond of him, she found his slow development trying and she became irritated by him. Despite this she had a realistic approach to the child, was affectionate and made good physical contact with him.

Contact with the neighbourhood

This was a well integrated, socialized family.

Personal history*Birth and early development*

The pregnancy was normal and he was born by normal delivery at 42 weeks. His birth weight was 4.1 kg (1 SD above the mean). At 1 week of age he was admitted to hospital for three weeks for investigation of his strange facial appearance and his inability to give a lusty cry. He was noted to have low-slung ears, a receding chin and an antimongoloid slant of the eyes. Chromosomal investigation revealed that he had a partial deletion of one of the fifth pair of chromosomes. He had, therefore, a cri-du-chat syndrome. All his milestones were delayed. He began crawling at 19 months, sat unsupported at 2 years and was just walking at 4 years but did not speak although he was babbling and mimicking consonants. He was breast-fed for 3 months on demand and then transferred to the bottle. He sucked poorly and when solids were introduced at 8 weeks he persistently refused these until 2 years 6 months. However, he had a good appetite and by 3 years 6 months had learned to feed himself with a spoon and hold a cup. He did not present any problems with sleeping and had no major illnesses. At 3 years 6 months he was clean day and night but he was not dry by the age of 4 years.

Childhood separations and periods of loneliness

Robert had been cared for consistently by his parents and an au pair girl but had been separated from his mother when she was admitted to hospital for two weeks for the birth of her last baby and also during his own hospital admission. These appeared to have no adverse affect on him. He attended a day nursery, in the mornings only, from the age of 3 years. At this age he was frequently left alone in a room when his parents were otherwise occupied. It was during these periods of loneliness that his pica gave cause for concern and precipitated arrangements for admission to nursery school.

Pica

He developed pica from approximately 9 months of age but this was of very gradual onset and only between the ages of 3 years and 3 years 6 months did this

become a major problem. At 3 years 6 months he was eating chalk, crayons, pencils and clothes-pegs; he would eat earth when in the garden and chew the furniture or his cot when indoors. He had been known to swallow hairpins. He also ate matches and newspapers; he would chew any plastic toy and sought paint flakes and plaster from the walls to swallow. His particular interest was chewing the window-sill and this he did when he was alone in his playroom. At the seaside he ate stones and sand, and chewed his spade and bucket. In addition, he liked licking money, glass and particularly the metal fittings in the car. He indulged in pica many times each day but when made to stop did not resume immediately and showed no signs of annoyance if the objects were removed from him. It was felt that his pica was related to boredom and his mother expressed anxiety and guilt that, during house removal when he was 3 years, he had spent much time shut in a room alone when, despite the presence of toys, he preferred to chew the window-sills. Both parents had been aware of safety factors in the house, all tablets being locked in a high cupboard and all crayons checked for non-toxicity.

Between 3 years 6 months (the time of his admission to nursery school) and 4 years his pica gradually improved. His parents had also become aware of the dangers of loneliness for him and avoided this. His play had developed and he could occupy himself with simple constructive toys.

Feeding problems

Persistent refusal to accept solids until 2 years 6 months caused maternal anxiety. Until then he was fed on a purée diet and any lump caused him to choke. A developmental defect of the oesophagus was considered at one time because the larynx was known to be abnormal in these children, but such a defect was excluded at oesophagoscopy. After 2 years 6 months he ate small pieces of solid food but still had difficulty in chewing and swallowing.

Investigations

When he was 15 months his haemoglobin was 11.9 g/100 ml (81 per cent). At 18 months it was 11.7 g/100 ml (80 per cent). At 2 years his height was between percentiles 75 and 90 and his weight was between percentiles 50 and 75. His blood lead level was 62 µg/100 ml and his haemoglobin was 11.5 g/100 ml (78 per cent) at 3 years 5 months. His height was between percentiles 75 and 90 and his weight between percentiles 50 and 75 at 4 years.

Treatment

At 3 years 5 months he was treated with two courses of penicillamine, each lasting one month. Following this treatment his blood lead level was 41 µg/100 ml. His haemoglobin on that occasion was 11.3 g/100 ml (77 per cent) and the blood film was normal. A final blood lead level, when he was 4 years 4 months, was 30 µg/100 ml.

Robert H.
Aged 4 years.

Personality profile

Mentally retarded. No pica when profile constructed.

Aggressive					Submissive
Noisy					Quiet
Attention seeking					Isolated
Disobedience					Passivity
Over-activity					Apathy
Destructive					Not destructive
Rigidity					Adaptability
Independence					Timidity
Irritability					Affability
Obstinacy					Amenability

Psychological assessments

Psychological assessments, taken over the years, using the Griffiths Mental Development Scale, were as follows:

	<i>Aged 8 months</i>	<i>Aged 17 months</i>	<i>Aged 37 months</i>
Locomotor quotient	85	64	48
Personal-social quotient	85	72	51
Hearing and speech quotient	59	60	33
Eye and hand quotient	93	73	53
Performance quotient	93	65	56
General quotient	83	67	48

The final test indicated that Robert was functioning as a borderline SSN/SN child. His scores were consistent on all subscales, except the hearing and speech subscale on which he scored less well.

Progress

When he was 4 years the family emigrated to Australia, taking Robert with them, and so further detailed follow-up was impossible. However, by regular correspondence it was learned that Robert remained free from pica and made steady developmental progress. By the age of 4 years 4 months he had a few words, was almost toilet trained, could feed himself and no longer had difficulties in chewing and swallowing. He took an active interest in various simple constructional toys. His blood lead level was within normal limits.

Diagnosis

Cri-du-chat syndrome with mental retardation, pica and specific difficulties in speech and swallowing.

CASE HISTORY OF ARTHUR J.

Date of birth: 1 December 1961

Age when referred for investigation: 3 years 9 months

Length of follow-up: 4 years

General background

Family background

Arthur's mother was 25 years at his birth and in good health. She had worked as a beautician before her marriage. His father was also 25 years at his birth, had a university education and, apart from some minor neurotic complaints, was in good health and worked as an insurance officer. He left the home when Arthur was 1 year 6 months, remarried and had no further contact with the family. Arthur's mother and maternal grandmother appeared to be the effective family unit for the first four years of his life, but under severe

strain. The maternal grandmother ran a day nursery and Arthur's mother worked full-time as a nursery assistant. Arthur was accommodated in the nursery during the day but disrupted this and caused constant friction between his mother and grandmother. When he was 4 years his mother obtained a council house and lived on her own with her three children.

Siblings

Luke and Arthur were twins, Arthur being the second born. Luke developed normally. The third child, Adam, a half-brother, born in 1964, was slow to develop and at the age of 5 years had an IQ of 77 (Stanford-Binet). He had no pica.

Housing and finance

The family unit lived initially in a semi-detached house in a pleasant locality, but they were confined to the four upstairs rooms, the three rooms downstairs being used for the day nursery. They had the use of the bathroom, toilet and garden. The council house to which they moved was also adequate in size, with all modern amenities and a garden. Their financial position was difficult following the father's departure. The mother maintained the family on Social Security and contributions from her own mother.

Subjective assessment of parental competence

Despite the difficulties in this family, the mother remained fond of her three children and looked after them well. She felt that Arthur was attached to her and needed her even though she was at 'breaking point' on occasions because of his behaviour. She refused long-term hospital care for him and only resorted to one short period of care in hospital when there was a family difficulty. By 7 years of age Arthur had become strong and self-willed and his mother felt her affection for him to be declining.

Contact with the neighbourhood

This was a well integrated, friendly family.

Personal history

Birth and early development

Twins were diagnosed during pregnancy and spontaneous labour was premature at 36 weeks. The first twin was a breech and the second twin, Arthur, was born by forceps delivery 24 hours later, birth weight 1.8 kg (more than 2 SDs below the mean). His neonatal condition was poor and he was in an incubator for two weeks. Both twins were fed with expressed breast milk for a short period and then transferred to the bottle. Arthur's milestones were delayed apart from his motor milestones, which were normal. Unusual

withdrawal and possible deafness was noted at 9 months at a routine clinic hearing test. The deafness was refuted by several later examinations. Toilet training was very slow, but by the age of 7 years 6 months he had only occasional nocturnal enuresis and was usually fully independent for the toilet. He could dress and undress himself, find things he had put away, had good road sense and could use a knife and fork. His first words were at 1 year, but he never progressed beyond the occasional single word. He was restless at night and had difficulty in getting to sleep.

Childhood separations

At 1 year 10 months he was admitted to hospital for two weeks for an operation on an internal squint. He was said to have been adversely affected by this (see below). At 3 years 4 months he was admitted to a subnormality hospital for six weeks. He started to attend a day special school for severely subnormal children at 5 years.

Difficulties during development

Behavioural problems.—Before 1 year 10 months he was a difficult child but after admission to hospital at that time his difficulties were accentuated and continued throughout childhood. He would run away or wander about aimlessly, try to get out of his cot the moment he woke up, resisted all attention or affection and preferred to be on his own. He took little notice of other children. There seemed to be a specific antagonism between mother and child as he became distressed whenever with her, screaming, kicking and pulling her and struggling to get away—and yet he resented her paying attention to anyone else. His favourite occupation was playing with wheels and he would turn over toys and spin the wheels for hours at a time. Throughout the period of follow-up he remained an isolated, manneristic child, aimless in his activities unless he had one person's full attention.

Feeding problems.—These had always been prominent. He was a difficult child to feed initially because of vomiting, although he had a large appetite. Solids were started at 6 months but he refused to eat lumps in his food until 7 years. He was therefore fed on purées and baby cereal. Later he refused to sit down for his meals and would not use a spoon himself although he could manage a knife and fork. He insisted on drinking fluids from the baby's bottle, and would drink up to $2\frac{1}{2}$ pints of milk a day in this way. In between mealtimes he would not be parted from his bottle and carried it with him, sucking the teat.

His appetite, which had been unusually large until 2 years of age, then gradually waned and he became a poor eater with frequent diarrhoea, abdominal pain and vomiting. When his pica improved at 4 years his appetite improved but he continued to suck his bottle and eat most of his meals alone until he was about 7 years, when he gradually began to conform to the family feeding habits.

Pica

At 8 months, when he began to crawl, he started to chew his cot and other painted and veneered objects. He would chew flakes of paint and strips of wood from toys. At 2 years 6 months his mother noticed flakes of green paint in his stool. She traced this to the old painted chest of drawers in the garden which was subsequently burned. She also noticed that he liked to chew the drainpipe outside the house and lick the lid of the dustbin. She tried to deter him by smearing mustard on these, but without success. At 3 years 9 months he was licking prams and chewing the black rubber wheels of prams and bicycles. His pica was at its worst between 2 and 4 years. He was almost constantly eating or chewing painted objects, would flake paint from walls with his finger-nail and eat it, chew paint cans and once poured paint into his beaker to drink it. When reprimanded for eating paint he would stuff his mouth full of paper as if to stop himself eating paint. He indulged in pica each day, would stop when told but would find something else to chew. If stopped completely he would have a tantrum.

During this period he experienced long episodes of loneliness and lack of stimulation while his mother worked in the day nursery.

At 4 years Arthur's pica improved when his mother moved house and spent most of her day with him. She attributed the improvement to lack of loneliness and boredom, leading to an increasing sophistication in his play. He began to look at books, play with clockwork toys and throw a ball. She also felt that constant reprimand was an important factor in stopping his pica. However, pica still continued to be a minor problem and was specific for grease off wheels, grass and paper, until he was 7 years when it gradually ceased altogether.

Speech difficulties

He showed no progress in the acquisition of speech or in the development of comprehension of speech since 1 year. At 7 years he remained an almost mute child who did not respond to his own name, had one or two unclear words and understood almost entirely by gesture. This was regarded as an aphasia of both sensory and motor type and not amenable to speech therapy.

Admission to hospital

At 3 years 9 months he was admitted for six weeks for investigation of his mental subnormality and possible lead poisoning; his weight was between percentiles 25 and 50 and his height between percentiles 10 and 25; his head circumference was normal. There were no abnormal physical findings apart from a bilateral internal squint that had been partially corrected by surgery.

Investigations

His haemoglobin concentration was 10.3 g/100 ml (70 per cent) and his

blood lead level 62 $\mu\text{g}/100\text{ ml}$. Examination of the blood film revealed the occasional stippled red blood cell. X-ray revealed foreign bodies throughout the abdomen and lead lines in the pelvic bones. Urine showed an excess excretion of delta-aminolaevulinic acid. Blood lead levels of Arthur's two brothers were normal.

Behaviour in hospital

Arthur's behaviour in hospital was much as his mother had described at home. He was a solitary, manneristic child, actively avoiding contact with adults and other children and totally preoccupied with his own activities. He was either licking, sucking or chewing at rubber tyres or painted wood, or else he had his bottle of milk in his mouth. No words were heard and he appeared to understand very little. Deafness, however, was not present. He was doubly incontinent and difficult to feed, taking only a minced diet when this was forced upon him.

Treatment

He was treated with a course of penicillamine and pyridoxine, lasting four weeks. Two weeks later his blood lead level was 74 $\mu\text{g}/100\text{ ml}$. His haemoglobin level remained stable.

Between 4 years and 4 years 6 months he received three further courses of penicillamine as an out-patient, each course lasting one month. Blood lead levels fell from 69 to 48 $\mu\text{g}/100\text{ ml}$ during this time.

Psychological assessments

At 3 years 10 months he was functioning on the Piaget sensorimotor scale at stage VI (18–24 months). On the Ad Hoc Development Scale of Functional Attainment his locomotor development was greater than a 36 month level, feeding and speech attainments were at a 6–9 month level and ability in dressing and toilet training at a 12–15 month level. The conclusion was that this child was severely subnormal. The discrepancy in his development, with marked retardation in speech and feeding, and relatively advanced locomotor ability were noted.

His intelligence was assessed once more at 7 years 4 months, and on Stanford–Binet Intelligence Scale (L-M) he attained an approximate IQ of 27 on non-verbal items alone. His speech remained non-existent and so the discrepancy between his verbal and non-verbal abilities had become even wider.

Further investigations

At 7 years 6 months his blood lead level was 55 $\mu\text{g}/100\text{ ml}$ and his haemoglobin was 11.1 g/100 ml (76 per cent). He had received no treatment during the preceding three years and his pica had ceased. His height and weight were then between percentiles 50 and 75.

Arthur J.
Aged 7 years.

Personality profile

Mentally retarded. Pica a minor problem but still present.

Aggressive					Submissive
Noisy					Quiet
Attention seeking					Isolated
Disobedience					Passivity
Over-activity					Apathy
Destructive					Not destructive
Rigidity					Adaptability
Independence					Timidity
Irritability					Affability
Obstinacy					Amenability

Diagnosis

Pica and brain damage due to perinatal difficulties (second twin and neonatal asphyxia), resulting in severe subnormality with specific defect in speech and language development and pica.

CASE HISTORY OF MAUREEN K.

Date of birth: 19 November 1964

Age when referred for investigation: 2 years 7 months

Length of follow-up: 2 years

General background*Family background*

This was an immigrant West Indian family who had been in England since 1960. The father, 27 years of age at Maureen's birth, worked as a carpenter, was of normal intelligence and in good health. The mother, 21 years at Maureen's birth, was a steampress worker before the birth of her first child. She became schizophrenic when Maureen was 3 months old and had repeated admissions to a psychiatric hospital during the succeeding four years. Her symptoms varied from restlessness and depression to manic behaviour with delusions and hallucinations. Between hospital admissions when she was at home she was apathetic, cold and remote from reality. She had been unable to meet her children's physical or emotional needs from the beginning of her illness in 1965.

Siblings

The first child was born in 1963; Maureen was the second and then there were two further children, born in 1965 and 1967. The three siblings developed normally.

Housing and finance

The family owned a terraced house in a poor residential area and let the first-floor rooms to relatives. They had a large ground-floor flat with a garden, bathroom and inside toilet. The housing conditions were above average for local immigrant families. The financial position had always been difficult due to the mother's repeated illnesses and the father's enforced unemployment in order to care for the children.

Subjective assessment of parental competence

The father was a warm, understanding, kindly man who cared for the children in a realistic way and managed Maureen's difficulties exceptionally well. The mother had been ill for most of Maureen's childhood and required, when at home, a lot of attention from her husband.

Contact with the neighbourhood

This had been a well integrated family within the local immigrant population, but had become isolated because of the mother's illness and Maureen's problems. They received loyal support from their relatives in the same house.

Personal history

Birth and early development

The pregnancy was normal and Maureen was born at full term by normal delivery in hospital. There were no neonatal problems. Her birth weight was 3.4 kg (on the mean). She was breast-fed with no difficulty but was regarded as excessively hungry. Solids were introduced at 9 months. Her milestones were normal according to the history available from the health visitor. She was walking alone at 11 months, and was clean and dry when potted regularly at the age of 2 years. Her first words were at 1 year and also at 1 year she began to use a spoon and drink from a cup. She was regarded as quicker in her development than her two sisters, and seemed essentially a normal, rather bright child before her illness. Her appetite had always been exceptionally large.

Childhood separations

There had been no significant separations from her father with whom she had a good relationship, but the mother had little contact with Maureen.

Pica, admission to hospital and onset of epilepsy

The onset of pica was not remembered clearly but it had not been a prominent feature of her behaviour until she was 2 years 5 months. She was then found drinking an old can of paint, which was tested during the subsequent illness and found to be free of lead. Within two hours she had repeated convulsions and was admitted to hospital in a coma, when she was found to have a left-sided spasticity. There were no signs of raised intracranial pressure, nor any infection.

Initial investigations

The following day her blood lead level was 42 $\mu\text{g}/100\text{ ml}$. Her cerebrospinal fluid was normal.

Treatment and progress

Because her blood lead was marginally raised, she was treated with intramuscular EDTA for three days. Following a rapid recovery from coma, she ate coal, linoleum, paper, carpet, underfelt and also her own faeces. She stopped playing with toys and was generally destructive. She showed strange behaviour, with periods of head banging, and she was aggressive. She remained in hospital for three weeks and a diagnosis was made of brain damage due probably to an unknown toxic substance.

Second admission to hospital

Two months later she was readmitted with further convulsions. She was

given anticonvulsants, initially phenobarbitone; then this was changed to phenytoin and primidone, and subsequently to phenytoin and diazepam.

She was found to be chewing the cot sides and the blankets and to be biting adults and children. She was of heavy build, agile and hyperkinetic. She was said to eat everything that was within her reach. It was thought that her pica might have been due to excessive hunger and she was given as much as she wanted to eat whenever she asked for it. Her pica, however, remained unaltered. She was destructive and had long episodes of banging her head against the wall.

Examination and investigations during the second admission to hospital

At 2 years 7 months she was a well built muscular child. Her height was between percentiles 75 and 90; her weight was above percentile 97. Her head circumference was 1-2 SDs below the mean. She had no abnormal physical signs.

Investigations

Her haemoglobin was 10.7 g/100 ml (73 per cent); 17-ketosteroids and 17-hydroxycorticosteroids were examined because of her unusually muscular development, and these were normal. Several blood lead estimations were also normal. A skull x-ray revealed no abnormality. X-ray of her abdomen revealed no radio-opaque material in the abdomen and no lines of increased density in the pelvic bones. An EEG was abnormal, showing high voltage spikes in the right central region as well as an excess of slow activity.

Psychological assessment

Assessment at 2 years 7 months showed that her play was at a developmental level of 15-18 months (Piaget sensorimotor scale stage V-VI). Her speech development was at an 18-24 month level. Locomotor development and feeding were normal at a 2-3 year level; dressing and toilet training were at a 12-15 month level. She was thought to be functioning in some respects as a normal child and in others at a subnormal level, but in no way at a severely subnormal level.

Behaviour

She remained boisterous but interested in people and made adults aware of her presence, enjoying being picked up and cuddled. She was aggressive towards other children, biting and kicking them. She had a great deal of energy and enjoyed playing with large equipment. She spent much of her time chewing soft toys and in other pica activity.

After four months in hospital, at 2 years 11 months, she returned home to the care of her father.

Third admission to hospital

She was readmitted to hospital at 3 years 6 months, when it was noted that she had made almost no progress since her initial illness. She remained very active but manageable. She babbled and occasionally would say an understandable word at an inappropriate moment. She was doubly incontinent and would feed herself messily with a spoon. She still had severe pica and was noted to eat stones, dirt, leaves and faeces. She would lie down on the road and drink from puddles. Her blood lead level remained normal.

Psychological testing when she was 3 years 8 months revealed no improvement in sensorimotor ability, which was still at Piaget sensorimotor scale stage V–VI (15–18 months). Functional attainments showed a deterioration in ability to feed herself (now at a 15-month-old level); her dressing had improved to a 24 month level, but toilet training remained at a 12–15 month level. She was still using only single words. She had made no progress over the previous year and was functioning at a severely subnormal level.

On returning home from this admission, Maureen attended a special care section of a day nursery full-time, where her behaviour and pica did not improve.

Fourth admission to hospital

She was readmitted to a subnormality hospital for long-term care at 4 years 4 months. She was still chewing paper, cardboard, plastic toys and wood; she did not suck her thumb. At the hospital school she ran about most of the time and did not settle with any of the toys. She did not play with the other children but sought attention from adults. She had lost all speech and no vocalization was heard. There had also been deterioration in her play and self-help skills. Full investigations failed to reveal a metabolic disease or any cause for the deterioration. Unfortunately, pica continued unabated and was almost constant and non-specific. Efforts to keep her occupied did not lessen her pica; she was boisterous and affectionate, having frequent minor fits and still had a large appetite. Her height and weight were both between percentiles 75 and 90. Results of repeated blood lead examinations were all below 40 µg/100 ml.

Haemoglobin levels between the ages of 2 years 7 months and 4 years 7 months remained between 10.3 g/100 ml (70 per cent) and 11.5 g/100 ml (78 per cent) despite two courses of intramuscular iron. She was then transferred to another subnormality hospital and no further follow-up was possible.

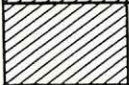
Diagnosis

Pica resulting in accidental poisoning and brain damage, severe subnormality and epilepsy.

Maureen K.
Aged 4 years.

Personality profile

After accidental poisoning: pica present.

Aggressive					Submissive
Noisy					Quiet
Attention seeking					Isolated
Disobedience					Passivity
Over-activity					Apathy
Destructive					Not destructive
Rigidity					Adaptability
Independence					Timidity
Irritability					Affability
Obstinacy					Amenability

CASE HISTORY OF CARL P.

Date of birth: 27 January 1961

Age when referred for investigation: 6 years 10 months

Length of follow-up: 2 years

General background

Family background

Carl's mother was 31 years at his birth, was in good health and was a part-time cleaner. Her scholastic level was poor and she could not read or write. His

father was 41 years at Carl's birth and suffered from migraine following a head injury at 20 years, when he was unconscious for 40 days. He could not read at school but afterwards learned to do so. He was employed as an unskilled factory worker. Both the paternal grandparents had died, the paternal grandmother being killed in a car accident and her husband committing suicide soon after her death. There was a paternal uncle who suffered from schizophrenia and died in his early 30s. There was also a strong family history of dyslexia on the father's side.

Siblings

There were three children in the family: Jane, born in 1957, was intelligent and musical, and Bernard was 2 years younger than Carl and developing normally.

Housing and finance

The family lived on a council estate in an adequate semi-detached house, in good condition.

Subjective assessment of parental competence

Both parents tolerated Carl's peculiarities for five years and seemed placid about his difficulties. There were few disagreements between them over issues concerning Carl. Despite poor academic attainments, both parents appeared to be of average intelligence. They coped well with their family and were accepting and understanding over the various problems that had arisen.

Contact with the neighbourhood

This was a well integrated family, well liked in their immediate neighbourhood.

Personal history

Birth and early development

The pregnancy was normal and he was born at home after two days of difficult labour at full term; his birth weight was 3.7 kg (mean to 1 SD above the mean). He smiled early but sat unsupported rather later than his older sister. His mother had ascribed this to his being a heavy baby. He stood holding on to furniture at 13 months and walked alone at 15 months. His first words were unusually delayed, at 3 years 6 months. He was breast-fed for 8 months by a regular feeding regimen. He was not given oral comforters since he was an easy baby to care for. Solids were started at 6 months and he had a very large appetite. He was late being toilet trained as his mother found this impossible before 3 years 6 months due to his negativism. He was clean and dry by day at 4 years 6 months, and dry at night at 5 years 6 months. He disliked going to bed because of a persistent fear of the dark.

Physical illnesses

Carl complained of headaches and appeared on some occasions to be copying his father.

Childhood separations

There were no prolonged separations, both parents helping to look after him and his older sibling taking some responsibility for him.

Behavioural difficulties

Severe temper tantrums and screaming outbursts began when he was 2 years, coinciding with the birth of his younger brother. He gradually became more restless and distractible, with uncontrolled wild behaviour on occasions. He would bang and slap his head and induce regurgitation of food. He was easily upset and showed a catastrophic reaction when reprimanded. He had sucked his fingers almost constantly since babyhood and insisted on the use of comfort blankets in bed at night. Bruxism was severe throughout childhood so that he had worn down his teeth. He showed manneristic movements with his hands and frequently bit his nails. His mother described him as 'fidgety', and much of his movement seemed wild and aimless. He had episodes of jealousy and bad temper and would become aggressive. He was not liked by his peers because he cheated in games. He was easily frightened by loud noises.

During the first two years of school he had received much criticism. He was described as inattentive, his scholastic application was weak, he had a low frustration threshold, was extremely self-centred, over-excitable, uncontrollable and particularly inept in organized activity. His speech was difficult to understand, and his educational progress erratic and poorly sustained.

Pica

Carl's pica started in his pram at 8 months when he began to chew the pram covers. When he was in his cot he would chew the bars. His pica then became more obvious when he was crawling and later when walking, and at 7 years was one of the many problems for which the parents sought help. He had chewed blankets, crayons, pencils and his own clothing. He ate earth from the garden, paint that flaked off the outside of the house, twigs and leaves that he found in the garden and in particular he chewed the garden fence. He picked holes in the walls and ate the plaster. He ate matches, newspapers and plastic toys. Even at the age of 7 years any toy that he was given would go straight into his mouth. He had mouthed but not swallowed many other objects such as buttons, money, shoe-laces and anything wooden. He had licked the paint on the garage door and chewed the toes of his plimsolls until beyond repair. He indulged in pica many times each day and when told to stop did so but resumed almost immediately. He actively sought objects to chew and was annoyed if he was stopped from doing this. His parents felt that his pica was initially related

to boredom but had then become a habit which he could not break. He had been reprimanded by smacking and shouting. His parents did not realize it was harmful and were not anxious about it, but regarded pica as naughtiness. Because of the amount of destruction that ensued they hid objects and tried to keep watch on him.

His pica improved at 8 years and he stopped chewing wood in the garden. He still chewed pencils, ballpoint pens and the occasional toy, but his parents thought this was hardly more than the normal child. He continued to bite his nails. Factors coinciding with the improvement in pica were, firstly, remarkable progress in speech with less frustration over communication failure, secondly, an improvement in behaviour at school and, thirdly, a reorientation of parental attitudes about the symptom.

Feeding problems

He always had an almost insatiable appetite with no food fads. His appetite did not wane even when his pica was at its worst.

Sibling rivalry

Carl was nearly 2 years when Bernard was born at home. There was no separation from his mother and he showed no undue distress for the first three days, but on the fourth day screaming attacks started. He resented attention being given to the baby and wanted his mother to himself. When she was breast-feeding, Carl insisted on climbing on to his mother's knee and staying there. He continued to be resentful of his younger brother throughout childhood.

Delayed speech development

His first words were at 3 years. Before that his parents felt that his speech was delayed because he always managed to get what he wanted without using words. At 3 years 6 months he attended a speech therapy clinic where a diagnosis of dyslalia and dysphasia was made. His hearing was assessed and found to be normal. He received regular speech therapy, resulting in some improvement. At 5 years his speech was still difficult to understand, with immature substitutions and telegrammatic phrases. However, between 7 and 8 years there was a spontaneous, rapid improvement in his speech.

On examination

At 7 years his height and weight were above percentile 97. He was a good-looking boy who looked older than his years. He showed choreiform movements of all limbs, head and trunk and facial grimacing. He also showed 'mirror' movements on attempted fine movements of one hand. He was ambidextrous and clumsy.

Carl P.
Aged 8 years.

Personality profile

'Minimal brain damage.' No pica when profile constructed.

Aggressive					Submissive
Noisy					Quiet
Attention seeking					Isolated
Disobedience					Passivity
Over-activity					Apathy
Destructive					Not destructive
Rigidity					Adaptability
Independence					Timidity
Irritability					Affability
Obstinacy					Amenability

Investigations

His haemoglobin was 15.3 g/100 ml (105 per cent) and his blood lead level was 29 µg/100 ml. An EEG recording when he was 8 years 3 months showed a mild diffuse abnormality without any clear signs of a focal lesion or any definite paroxysmal features. On clinical and EEG findings, a diagnosis of 'minimal brain damage syndrome' was made.

Psychological assessment

When tested at 6 years 10 months, using the Wechsler Intelligence Scale for Children, he scored a full-scale IQ of 111, verbal IQ of 99 and performance IQ of 122. Tests of arithmetic ability showed attainments within the expected range but he could not read.

This verbal/performance discrepancy just achieved statistical significance at the 5 per cent level. He appeared to be well within the bright normal intellectual ability range, with some specific difficulty in verbal accomplishments. Much of his learning difficulty seemed contingent upon delayed and inadequate speech development and dyslexia, but was made worse by hyperkinesis and his other behavioural problems.

Further assessment of his intelligence at 8 years 7 months, using the Wechsler Intelligence Scale for Children, revealed a verbal IQ of 113 and non-verbal IQ of 97. His ability in the various subtests revealed a remarkable improvement in his verbal capacity compared with previous tests. However, his reading ability was still poor and his persistence with academic tasks not sustained. His headmaster reported that there had been an improvement in his behaviour at school although he remained over-active, volatile and could be defiant.

Diagnosis

Minimal brain damage with hyperkinesis, pica and a resolving developmental speech disorder. History of possible perinatal brain damage.

CASE HISTORY OF MARTIN R.

Date of birth: 27 January 1966

Age when referred for investigation: 2 years 9 months

Length of follow-up: 2 years

General background*Family background*

Martin's mother was 34 years at the time of his birth and was in good health. She worked as an insurance clerk before her marriage. His father was 36 years and worked as a shipping office clerk and was also in good health. Both parents had had a grammar school education.

Siblings

The mother's first pregnancy ended in a spontaneous miscarriage; then she had a girl, born in 1964. This was a child of good intelligence but had some difficulties in relation to her handicapped brother; she over-protected Martin

and was constantly anxious for his safety. This improved when she attended nursery school at 4 years. Martin was the result of the third pregnancy and then there was a baby born in August 1969, just before the final follow-up.

Housing and finance

This family owned their semi-detached house, built in 1930 in an urban area. It was generally in poor condition. There were no major financial problems, the father being in regular employment.

Subjective assessment of parental competence

The father was deeply involved in his handicapped child and worked in his spare time as press officer for the local branch of the Society for Mentally Handicapped Children. The mother was a retiring type, devoted to all her children but found that Martin took most of her time. She periodically became depressed over his many problems, which she saw as insoluble.

Contact with the neighbourhood

This was a well integrated family.

Personal history

Birth and early development

Martin was the result of a full-term pregnancy and delivery was normal, at home. Birth weight was 3.2 kg (mean to 1 SD below the mean). There were no immediate neonatal problems. He smiled at 7 months, sat unsupported at 12 months, when he also began to grasp objects around him, stood holding on at 14 months and walked alone at 17 months. He was breast-fed for 4 months on a regular schedule and he was not given a dummy. Semi-solids were started at 6 weeks. At 14 months he managed a cup and started to finger-feed. At 3 years 6 months he managed a spoon but was still finger-feeding as well. He had been a difficult child to get to sleep at night and was very active on waking in the morning. His first words were at 15 months but he did not use speech for communication until 3 years. At 3 years 6 months he had 5 or 6 fairly clear words which he used meaningfully, but his understanding of speech was more advanced. His mother started his toilet training at 12 months but at 3 years 9 months he was still wearing training pants and was wet and dirty. He had learned to undress himself by this age but could not dress.

Feeding difficulties

He was a hungry baby and inclined to regurgitate. He continued to have a good appetite, but always had some difficulty in swallowing solids and at 3 years 6 months still did not chew properly, tending to choke when lumps were in his food.

Childhood separations

He was never left unsupervised and only on rare occasions did someone other than his mother care for him in babyhood. He had not attended a day nursery. At 3 years 3 months he was admitted to a home for subnormal children when the younger child was born. This appeared to have no adverse effect on his behaviour.

Pica

Pica was first noted at 18–20 months, soon after he learned to walk, when he was cutting his molar teeth: he started by eating the paint off his cot when he woke up in the morning. This cot was examined by the public health department and a high lead content (18 per cent) was found under the top coating of lead-free paint. His pica gradually became more severe and was at its worst at 2 years to 2 years 3 months. During this time he ate ashes from the grate, chalk, a great deal of coal and dirt from the garden; he continued to chew his cot and chewed the window-sill and painted chair. He ate his own faeces, plastic toys, soap and chewed on forks and spoons. As his older sister began to have crayons he ate these. Pica occurred practically all the time. He would stop when he was told but would resume immediately his mother's back was turned. He would only be stopped finally by personal intervention and by removing the object he was chewing. Pica was most marked early in the morning and was possibly related to boredom. His parents reprimanded him by smacking, although they felt this was a developmental stage in a handicapped child. They became irritated by his behaviour because he was so destructive in the house. They covered up the furniture and replaced his cot by a bed.

His pica gradually improved and by 3 years 6 months this was no longer a major problem since he was only occasionally mouthing, and swallowing these objects had become very infrequent. At the time his pica improved, his mother had noticed a general increase in awareness of the world around him and he had become involved in play activities such as throwing, paddling, water play in general and in-and-out play.

Behaviour problems and mental retardation

Mental retardation was suspected at 9 months when he was not alert or interested in his surroundings. This was subsequently confirmed by his slow development and on two later psychological assessments. Most of his behaviour problems were associated with his backwardness. At 2 years he was an active child but clumsy and frequently falling over. He had no sense of danger. He did not communicate, had temper tantrums, sucked his thumb or fingers, banged his head on his cot and occasionally induced regurgitation. He showed occasional hand mannerisms.

By 3 years 9 months his behaviour problems had improved. He had a better sense of danger although this was still not sufficient to allow him to be

unsupervised at any time. He was beginning to communicate and had fewer temper tantrums. He became an affectionate child, enjoying physical contact but would occasionally bite adults and other children. He would continually throw his toys and this was an annoying aspect of his behaviour in the house. He was no longer sucking his fingers or thumbs, and had stopped head banging and self-induced regurgitation.

Onset of epilepsy

His first fit occurred at 18 months. Investigations in hospital revealed no abnormalities and a lumbar puncture revealed normal cerebrospinal fluid. He had a further fit at 2 years, when the history of pica was revealed and a blood lead level of 63 $\mu\text{g}/100\text{ ml}$ was found, but no treatment given. Phenobarbitone was started at 20 months and phenytoin was added at 2 years 3 months. He had no fits after medication was started.

On investigation

At 2 years 1 month, when his pica was at its worst, his haemoglobin level was normal but his blood lead level was 90 $\mu\text{g}/100\text{ ml}$; again no treatment was given. At this time the public health authorities identified large quantities of lead in some home-painted chairs and in his cot and these were removed from the house. At 2 years 6 months his blood lead level had fallen to 58 $\mu\text{g}/100\text{ ml}$ and at 2 years 11 months it was 11 $\mu\text{g}/100\text{ ml}$.

An EEG at 20 months revealed no epileptic features and a further one six months later was also normal. At 3 years 9 months his weight was between percentiles 50 and 75, his height between percentiles 25 and 50 and his haemoglobin was 12.5 $\text{g}/100\text{ ml}$ (86 per cent).

Psychological assessment

At 2 years 9 months the Griffiths Mental Development Scale gave the following results:

Personal-social	quotient 39; MA 57 weeks
Hearing and speech	quotient 40; MA 58 weeks
Eye and hand	quotient 39; MA 56 weeks
Performance	quotient 29; MA 43 weeks
Locomotor	performance beyond 2 years level

He was functioning as a severely subnormal child. He was a difficult child to test because his main interest was throwing everything offered to him. He enjoyed rolling balls and banging on different surfaces. His gross locomotor ability was good and he was interested in climbing. Apart from his locomotor skill, which was at a 2-3-year-old level, his other attainments seemed fairly consistent with a mental age of 12 months.

He was re-assessed at the age of 3 years 6 months when the results were:

Personal-social	quotient 40; MA 72 weeks
Hearing and speech	quotient 36; MA 64 weeks
Eye and hand	quotient 38; MA 69 weeks
Performance	quotient 34; MA 62 weeks
Locomotor	performance beyond 2-3 year level

At 4 years 9 months he was still functioning within the severely subnormal range but his ability to communicate had improved so that he was no longer frustrated. There had been no recurrence of pica. He was still over-active and

Martin R.

Aged 3 years 9 months.

Personality profile

Mentally retarded. No pica when profile constructed.

Aggressive					Submissive
Noisy					Quiet
Attention seeking					Isolated
Disobedience					Passivity
Over-activity					Apathy
Destructive					Not destructive
Rigidity					Adaptability
Independence					Timidity
Irritability					Affability
Obstinacy					Amenability

lacking in an appropriate sense of danger. He was awaiting admission to the junior special school. His ability to play was much improved and he could now occupy himself if left alone for short periods of time.

Diagnosis

Severe subnormality of unknown aetiology, epilepsy and increased lead exposure secondary to pica.

CASE HISTORY OF ALISTAIR T.

Date of birth: 15 May 1964

Age when referred for investigation: 2 years 0 months

Length of follow-up: 3 years 6 months

General background

Family background

Alistair's mother was 26 years and his father 22 years at his birth. Neither had had an adequate education. The father worked as an odd-job man, had a criminal record and had been in prison. When Alistair was 4 years old the parents separated and the mother cohabited with a man who related well to the children and gave the family financial stability.

Siblings

The first child, Ronald, was aged 3 years 7 months at the time of the initial referral. Ronald was also investigated, because he had had a history of pica for two years and was found to have raised blood lead levels. Like his brother, he chewed the window-sills. There were no younger children.

In addition to these children, two cousins were investigated who lived near to the family and whose family dynamics were similar. They were also found to have pica for painted wood, in particular the window-sills, and had raised blood lead levels. All four children received treatment for lead poisoning. Important aetiological factors in the pica of the cousins appeared to be a striking lack of toys and long periods of loneliness.

Housing and finance

The family lived in a small, poorly furnished flat in a Trust Organisation, occupied by families of the lower social classes. The flat was in poor condition, there was a shared toilet and washbasin but no bath. There was no outside playing space because lorries drove at speed across the courtyard. When first seen, the flat appeared to have been invaded by an army of rats because of all the chewing of wood that had occurred.

Initially, the financial position had been difficult because of the father's prison sentences, and even when he was working his wages were poor.

Following the separation, the mother managed on Social Security until her cohabitee contributed regularly.

Subjective assessment of parental competence

The father refused to be interviewed initially because he was antagonistic towards medical care and there had been controversy over the management of the children. He was a neglectful husband even when at home and did not go to the hospital when the children were admitted for treatment. He spent two-thirds of his entire married life in prison. The mother had found it a struggle to cope with her family and the poor housing conditions, and she had been depressed periodically but not referred to a psychiatric clinic. She was inadequate and did not make the best use of the facilities available to her; her children appeared poorly cared for and dirty but well nourished.

Contact with the neighbourhood

Despite living in such a close community the family had kept themselves apart from their neighbours and the children were shut inside the flat for most of the day. This was thought to be due to the shame that the mother had felt about her husband's prison sentences.

Personal history

Birth and early development

The pregnancy was normal and delivery was normal at full term, his birth weight being 3.0 kg (mean to 1 SD below the mean). All his milestones were passed at the usual times. He sat unsupported at 6 months, stood holding on at 12 months and walked alone at 14 months. His first words were at 13 months and his subsequent speech development was normal. He was bottle-fed by a regular routine, was given a dummy to suck, and solids were started at 6 months. There were no early feeding problems and he had a normal appetite, although this diminished when his pica was at its worst. There was no sleeping problem at night. Toilet training was slow, probably because of lack of consistent handling and he was still wet day and night at 2 years. He was completely toilet trained by 4 years.

Childhood separations

There have been no significant episodes of mother/child separation.

Pica

Pica started when Alistair was 21 months and was noticed when he was taken to the casualty department at the local children's hospital three months later and admitted because of recurrent otitis media and tonsillitis. He had been eating the furniture, painted window-sills, the carpet, window-ledge, underfelt, ashes, earth, matches and stones. This had been associated with a deterioration

in his general condition and his appetite became poor. He was pale, miserable and sleepy but there was no vomiting or diarrhoea. He indulged in pica frequently each day but not constantly. When told to stop he would resume in a few minutes, having shown annoyance at being diverted. His mother felt that his pica was related to boredom and being isolated. She admitted that this had been a time of great difficulty at home, with her husband in prison, and the children had been shut in the flat alone for long periods of time. She felt anxious because both brothers were being so destructive within the flat. Both her children were smacked and threatened when they indulged in pica, but this had no effect.

On admission to hospital

He was noted to be miserable and pale when admitted to hospital.

Investigations

His height was between percentiles 10 and 25 and his weight was between percentiles 50 and 75. His head circumference was normal. Abdominal x-ray showed that his bowel was loaded with radio-opaque flecks presumed due to paint and x-ray of his wrist revealed increased density at the growing ends. His blood lead level was 160 $\mu\text{g}/100\text{ ml}$ and his haemoglobin was 8.8 g/100 ml (60 per cent). His blood film showed moderate basophilic stippling. Both ear-drums were inflamed and his tonsils were enlarged and covered in pus. Diagnoses of otitis media, tonsillitis, anaemia, pica and lead poisoning were made.

Investigations were carried out by the public health department in the home of this child, and the lead content of the scrapings from the window-sill was 1.15 per cent. No lead was found in the scrapings from his cot and the rocking-horse contained insignificant quantities of lead.

Treatment

He was treated with penicillamine, pyridoxine and ferrous sulphate.

Three weeks later his blood lead level had fallen to 69 $\mu\text{g}/100\text{ ml}$, his haemoglobin had risen to 13.4 g/100 ml (92 per cent) and there was no longer any basophilic stippling. Following ten further weeks of treatment his blood lead level had fallen to 55 $\mu\text{g}/100\text{ ml}$.

Behaviour

It was noticed that his pica stopped soon after admission to hospital, when he became fully occupied in the daily activities in the ward; his pica had ceased before his haemoglobin had risen or his blood lead level had fallen.

Psychological assessment

Psychological assessment was carried out at 2 years 5 months, using an Ad Hoc Development Scale of Functional Attainment, and revealed that he was a

Alistair T.
Aged 5 years 6 months.

Personality profile

Deprived child. No pica when profile constructed.

Aggressive					Submissive
Noisy					Quiet
Attention seeking					Isolated
Disobedience					Passivity
Over-activity					Apathy
Destructive					Not destructive
Rigidity					Adaptability
Independence					Timidity
Irritability					Affability
Obstinacy					Amenability

boy of apparently normal intelligence. He was discharged home ten weeks after admission.

Progress after discharge from hospital

Many interviews were held with the mother following the discovery that both children were affected by lead exposure and she became anxious about pica and the possible ingestion of further lead. She attended out-patient clinics with both children for a short while, but then began to fail appointments. The health

visitor supervised the family and made unsuccessful attempts to get Alistair to nursery school. However, his mother made an effort to occupy him during the day. He was allowed to go out to play with the other children and this he enjoyed. His pica recurred intermittently after discharge from hospital, but by 3 years 3 months this was no longer a problem in his behaviour. He remained a noisy, lively, mischievous child for the rest of the pre-school period. He was admitted at 5 years to the local day school.

At 5 years 4 months his blood lead level was 40 $\mu\text{g}/100\text{ ml}$ and his haemoglobin 11.5 g/100 ml (78 per cent). His height was between percentiles 25 and 50 and his weight was between percentiles 50 and 75. He had settled well at school and was creating no particular problems at home or at school.

Unfortunately, his brother relapsed at 6 years and had a second episode of lead poisoning following exacerbation of pica for painted wood. During the previous year he had been unhappy at school, made little progress, stopped playing and had shown regression in speech. Pica had recurred at the time of this behaviour disturbance.

Diagnosis

Pica and lead poisoning in a socially deprived boy of normal intelligence.

CASE HISTORY OF DONALD W.

Date of birth: 15 October 1954

Age when referred for investigation: 10 years 10 months

Length of follow-up: 4 years 8 months

General background

Family background

The mother was 39 years and the father 45 years at Donald's birth. Neither parent had done well at school. The mother's previous marriage was not successful and her husband died leaving her with an adult son with whom she had no contact. She became a bus conductress and met her second husband who was then a coach driver. They married eight months before Donald was born. Serious marital disharmony occurred in the present marriage as the children grew older. There was constant disagreement about the children, in particular Donald, and the father blamed the mother for most of the boy's difficulties. Initially, the father was a long-distance coach driver and saw the children only at intervals of several months. When Donald was 4 years old, the father changed his job to a bus driver and worked on shifts so that he could see more of his family.

Siblings

Donald was the first child and his sister was born 14 months after his birth.

She was of normal intelligence and was doing fairly well at school. She presented no major behaviour problems and never had pica. There was intense sibling rivalry and the children could not be left together, Donald being spiteful and aggressive towards his sister.

Housing and finance

The family lived in a small, old cottage with four rooms, a scullery, outdoor toilet and a garden. The house was warm and dry and well decorated and there were no major problems, apart from the lack of a bathroom.

There were financial difficulties when the children were young and the mother was not able to work, but as soon as they reached school age she worked as a canteen assistant and there have since been no major financial problems.

Subjective assessment of parental competence

The mother admitted she neglected one child for the other and usually it was her daughter who suffered. The mother was unable to cope with her son's difficulties because of her lack of insight into his problems and her feelings of rejection for him. She blamed her husband for lack of support when the children were young. She admitted she had disliked Donald from a young age. She was tense and agitated during interviews and agreed she was constantly bad tempered and easily upset. She admitted to little love for her children and none for her husband. The father was placid, warm and accepting of his children's difficulties, prepared to overlook them to prevent further family disruption.

Contact with the neighbourhood

This was a somewhat isolated family, apart from the younger child who seemed well integrated. Donald, however, had no friends.

Personal history

Birth and early development

The pregnancy and delivery at full term were normal. His birth weight was 2.7 kg (1–2 SDs below the mean). During the mother's pregnancy the family moved to live with and care for the paternal grandfather and they remained there until he died, when Donald was 2 years 6 months.

His early development gave rise to no concern. His milestones were just within normal limits: he sat unsupported at 9 months, stood holding on at 18 months and was a little late in walking, at 19 months. His first words occurred at 12 months and speech development was normal. He was bottle-fed by a regular routine and was never given a dummy. Solids were started at 4 months and there were no early feeding problems. He was said to have been a hungry baby, put on weight rapidly and his mother was told that she over-fed him. His

appetite was always large, with no food fads even at the time his pica was severe. He was always a difficult child to get to sleep at night and appeared to need very little sleep. His mother was strict about toilet training and he was clean and dry by the age of 3 years 6 months.

Childhood separations

His mother cared for him in early childhood but when he was 14 months he was looked after by his maternal grandmother for one month when his sister was born. When he returned home he appeared not to remember his mother, refused to acknowledge her and showed intense jealousy of the baby. This sibling rivalry continued. At 19 months he was admitted with his sister to a day nursery full-time when his mother left the home for two weeks. This was because of marital problems, financial stress and the burden of looking after her husband's incontinent father. Donald remained at the nursery on a daily basis until he went to school at 5 years. He was rarely left unsupervised as a child.

Pica

Pica started at approximately 4 years at nursery school. The onset was almost certainly gradual and not noticed by his parents for two or three years. The first definite comment was from his schoolmaster who was concerned that at 7 years he was eating up to four school pencils a day. He was found to be eating brittle plastic toys and the coverings of ballpoint pens. He had pieces of plastic in his pocket, in his bedroom and under his pillow. At 10 years he started to eat painted wood and would flake off the paint with his finger-nail. He also drank paraffin and oil.

Illnesses

At 18 months he was admitted to hospital with pneumonia, and made a complete recovery. At 7 years he had a tonsillectomy. At 9 years he had a severe head injury in a road traffic accident and was unconscious for a week with multiple fractures involving his arm, leg and skull. Following this head injury his behaviour disturbance became worse and he developed severe migraine. He had a further admission to hospital following attempted suicide by an overdose of aspirins at 11 years.

Behaviour disturbance

He was a lovable, affectionate child in early childhood but while at nursery school he became difficult, aggressive and negativistic. When he started school at 5 years he continued to be a difficult child and attempted to set fire to the classroom. At 8 years he was referred for psychiatric help to the local child guidance clinic when it was stated that he had a bad temper, was a persistent fire raiser, was always in trouble at school, had no friends and was generally

aggressive and antisocial. He bit his nails and constantly fidgeted. He attended the child guidance clinic for two years but there was no improvement in his behaviour.

On admission to hospital

He was referred to hospital because of behaviour disturbance, pica and increasing pallor when he was 10 years 10 months. He had eaten a large quantity of paint in the week prior to admission.

Investigations

His weight was between percentiles 10 and 25, and his height on percentile 10. A full blood count revealed a haemoglobin of 7.3 g/100 ml (50 per cent), reticulocytes 2 per cent and blood lead level 70 µg/100 ml. X-rays of the knee and wrist revealed no lines of increased density.

Progress and treatment

Within a few days of admission his behaviour disturbance was so severe that this required treatment in its own right. He had repeated explosive emotional upsets, at first depressive but later suggestive of a toxic confusional state. It was felt that his head injury and the metabolic upset of lead poisoning were relevant in the causation of his disturbed behaviour. While in hospital he received psychotherapy, when he admitted that he ate inedible materials partly as a means of comfort and partly with vaguely suicidal ideas. Sometimes his aggressive behaviour was directed towards himself, but at other times it was directed at others.

In addition to psychiatric help, he was treated with penicillamine and ferrous gluconate; his blood lead level gradually fell and his haemoglobin slowly rose. When he was discharged, two months after admission, his blood lead level was 44 µg/100 ml and his haemoglobin was 10.5 g/100 ml (72 per cent).

Unfortunately, absconding precipitated discharge from hospital with his behavioural problem essentially unchanged.

Psychological assessment

The Wechsler Intelligence Scale for Children was used and revealed a normal intelligence.

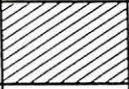
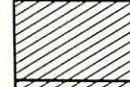
Subsequent progress after discharge from hospital

His behaviour problems remained severe. He continued to be an aggressive, destructive and isolated child with no constructive hobbies, no friends and poor academic attainments. He showed a little affection for his father but none for his mother. He fought with other children, was in trouble with the police after stabbing a boy with a screwdriver, and at 14 years was put on probation for demanding money with threats from a 9-year-old child. He was destructive with

Donald W.
Aged 8 years.

Personality profile

Continuing behaviour disturbance. Pica present.

Aggressive					Submissive
Noisy					Quiet
Attention seeking					Isolated
Disobedience					Passivity
Over-activity					Apathy
Destructive					Not destructive
Rigidity					Adaptability
Independence					Timidity
Irritability					Affability
Obstinacy					Amenability

his toys, clothes and other possessions. He made holes in the walls of his bedroom and burned wooden furniture. He continued to bite his finger-nails.

Pica for wood and, in particular, brittle plastic continued but ceased suddenly at 15 years. At this time he was still on probation and had established a good relationship with his probation officer. He had also changed his school and was making better educational progress. He was then found to have an anaemia (haemoglobin level 7.8 g/100 ml; 53 per cent) and his blood lead level was 37 µg/100 ml. An EEG taken at this age was normal. His weight and height were between percentiles 3 and 10.

At the time of final follow-up, when he was 15 years 6 months, he had no pica and was receiving iron. His haemoglobin level was then 11.6 g/100 ml (79 per cent). His behaviour, however, was still causing difficulties at home and at school, and plans were made for him to leave home and undertake some form of residential training as soon as he left school.

Diagnosis

Aggressive behaviour disorder in a boy of normal intelligence who had pica for plastic and painted wood.

Appendix B: Questionnaire used in Semi-structured Interview with Parents or Guardians of Child with Pica

Name:

Date of birth:

Date of interviews: 1.

2.

3.

Answers by:

DESCRIPTION OF PICA: DEVELOPMENT, TYPE, INTENSITY, TIMING AND PARENTAL REACTION

Development

When did pica start? (describe in detail)

When was it at its worst?

When did it stop, or is it still continuing?

Type

When his pica was at its worst (or at present time if severe now):

<i>Objects</i>	<i>Did he/does he swallow?</i>	<i>Did he/does he mouth but not swallow</i>
Ashes Balloons Blankets Buttons Carpet or rug Chalk Cigarette ash Cigarette stubs Cigarettes Clothes pegs Clothing Coal Crayons and pencils Earth Face cloths Faeces Furniture covers Furniture or cot Hair Hair pins House dust Matches Money Newspaper Paint flakes Plastic Pram Shoe-laces Shoes Soap Toilet paper Towels Toys Wallpaper Window-sill Wood (outside) Any other		
Score:		
Most frequently swallowed:		
Most frequently sucked:		

Intensity**Frequency:**

1. Less than once a week.
2. More than once a week but not daily.
3. 1-3 times a day.
4. Frequently each day but not constantly.
5. Practically all the time.

Resistance to control:

1. Stops when told, does not resume.
2. Stops when told but resumes in another situation.
3. Stops when told but resumes in the same situation in few minutes.
4. Stops when told but resumes immediately.
5. Does not stop.

Degree of compulsion:

1. Shows no signs of annoyance when object is removed (or removed from object).
OR
Needs nothing to divert him after stopping him.
2. Shows annoyance at being stopped.
OR
Will only stop when something else is given.
3. Is only stopped by personal intervention.
4. Resists or ignores all above.
5. As above *and* will remove obstructing objects to reach pica material.

<i>Personal observation</i>	<i>Indirect information</i>

Timing

Is it related to:

1. Boredom?
2. Mealtimes?
3. Being alone?
4. Same all the time?
5. Anything else?

Is there any situation in which it is least marked?

Parental reaction

How do you respond to his pica?
(elicit immediate response)

Comments

Comments

1. Ignore.
2. Reprimand—if yes, how?
3. Try to divert his attention.

Do you think it does any harm?
(if so, specify)

Do you feel anxious about it? Yes—No.

Do you think he thinks it is naughty? Yes—No.

Why do you think he started doing it,
and why has he continued?

Have you tried to prevent pica? If so, how? (elicit
long-term planning)

When did you know about the dangers of chewing,
and who told you?

FAMILY STRUCTURE

	<i>Year of birth</i>	<i>Scholastic level reached *</i>	<i>Handicaps</i>
Mother		1. 2. 3. 4.	
Father		1. 2. 3. 4.	
Children:			
1.			
2.			
3.			
4.			
5.			
6.			

* Scholastic level of parents:

1. Grammar school education.
2. Secondary modern school education.
3. Uncertain of type of school, but academic achievements poor, or special schooling.
4. Schooling almost non-existent and/or parent illiterate.

Other house occupants:

- 1.
- 2.
- 3.

Family situation

1. Husband, wife and child/children/half siblings.
2. Husband, wife and child and others (e.g. grandparent).
3. Two heads of household, of whom one or both are not the natural parents.
4. One head of household only.

Housing and finance

No. of rooms:

Garden:

Bath:

W.C.

General description:

Special housing problems

1. *None*; e.g. accommodation in good repair with inside use of bathroom and WC which may be shared. Use of garden.
2. *Some*; e.g. no use of garden. No bathroom. Outside WC (end of garden type, not just outside). Poor general repair. Damp. Bedroom space limited, e.g. 2 children with parents (accept 1 with parents as normal).
3. *Severe*; e.g. kitchen on different floor. Very poor condition of property. All condemned property. Difficult stairs. Sharing.

Financial difficulties

1. *None*; e.g. Adequate income. Child presents no financial problems.
2. *Some*; e.g. Mother not supported by husband, therefore needing to go to work. Payment for 'housekeeper' because of handicapped child. Care of child has caused financial difficulties.
3. *Severe*; e.g. Receiving Social Security. Obvious financial hardship.

Occupation of father

Occupation of mother Present/before marriage.

Social class

1. All non-manual workers including the professions.
2. Skilled and semi-skilled manual workers.
3. Unskilled workers, unemployed or casual labourers.

GEOGRAPHY OF CARE

Is anyone apart from mother needed to care for the child?

Not necessary	Maternal grandmother	Paternal grandmother	Father	Sibling	Other
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Does this happen:

1. In an emergency only?
2. Occasionally?
3. Every day?

Does he attend or has he attended:

1. Day nursery or nursery school?
2. Special care unit?
3. Special school?
4. School?

Episodes of mother/child separation (unavoidable)

Yes—No

How often, reasons and how did child react?

Periods of loneliness for child

Has the child been left for long periods alone or unsupervised?

1. Never.
2. In an emergency only.
3. Occasionally.
4. Every day.

List residential placements outside home (if applicable):

- 1.
- 2.
- 3.
- 4.

Mental and physical illness sufficient to disrupt family dynamics:

Mental illness in mother during subject's childhood

Mental illness in father during subject's childhood

Physical (chronic) illness in mother

Physical (chronic) illness in father

Yes	No	Not applicable	Comments

STANDARDS OF CARE

Maternal competence

Does mother think she:

Comments

1. Can manage both siblings and child?
2. Neglects one for other?
3. Not applicable (only child).

How do siblings react to child?

1. Within normal limits.
2. Tend to over-protect.
3. Ignore/quarrel/spiteful.

Evidence of disagreement over management of the subject

1. No evidence of disagreement
2. Only very occasional disagreement over something not routine
3. Disagreement mild
4. Evidence of considerable disagreement

<i>Interview with mother</i>	<i>Interview with father</i>

Observer's comment on material standards of child care witnessed during interviews

1. Gives the child everything he needs; diligent, competent mother, free from significant mental or physical illness.
2. Finds it hard to cope, possibly due to large family, poor housing or illness, etc., but manages fairly well considering the difficulties. A well-meaning mother.
3. Somewhat neglectful and does not manage as well as her circumstances might allow. Child appears poorly cared for.
4. Problem family; mother cannot cope; child appears under-fed, dirty, poorly clad, etc.

Emotional standards of child care

1. Parents have realistic approach to child despite the problems. Want to do everything they can to help. Mother demonstrative of affection and makes good physical contact with child.
2. Parents become intolerant of child at times. Little obvious affection seen during interviews—reprimanding. At other times genuinely very fond of child.
3. Intolerant and rejecting most of the time—others help with care because of this. Blame each other for child having a problem. Look on it as naughtiness rather than a disease. Intolerant of medical care because of this. Little physical contact. Occasional show of affection.
4. No affection and intolerance all the time. Child appears emotionally rejected by parents.

PERSONAL AND PSYCHOLOGICAL DATA

Developmental level and/or intelligence (obtain full details of tests with dates)

1. IQ before pica began
2. IQ during pica
3. IQ after pica ceased or at final follow-up if pica continued

Additional handicaps (list):

- 1.
- 2.
- 3.
- 4.

<i>Inferred</i>		<i>By formal testing</i>
<i>Before pica</i>	<i>During pica</i>	<i>After pica</i>

Habitual activities

	<i>Rare or never</i>	<i>Occasional</i>	<i>Only at certain times but daily</i>	<i>Almost constant</i>
<i>Oral activity</i> Thumb- or finger-sucking Use of comfort blanket Nail-biting Sucking bottle (after 2 years) (a) during day (b) in bed at night Gum-chewing Other				

cont.

	<i>Rare or never</i>	<i>Occasional</i>	<i>Only at certain times but daily</i>	<i>Almost constant</i>
<i>Other habitual activities</i> Head-banging Head-slapping Self-inflicted regurgitation Skin-picking Teeth-grinding Masturbation Other				

GENERAL PERSONALITY PATTERN

To be completed by mother or guardian

This scale is a simple measure of ten different aspects of the developing personality. Each of the ten aspects varies from one extreme of behaviour to the other. Please ring each number most appropriate to your own child. If you find that none is particularly appropriate, then ring the one nearest to the truth. Try to leave none blank and it is better to work quickly.

I Aggressive-Submissive

1. Has to be kept away from other children because of spiteful behaviour.
2. Occasionally spiteful, not in self-defence.
3. Defends himself against attack.
4. Allows himself to be attacked.

II Noisy-Quiet

1. Troublesome because of screaming or shouting (each day).
2. Occasionally screaming or shouting (1-2 a week).
3. Rarely screams or shouts and only for a reason.
4. Very quiet child.

III Attention seeking-Isolated

1. Constantly wants and seeks attention. Cannot accept shared attention.
2. Likes attention and occasionally seeks it. Can accept shared attention.
3. Indifferent to attention. Likes to be alone, or with other children.
4. Resists attention. Actively avoids adults. Isolated child.

IV Disobedience-Passivity

1. Very disobedient and resistive.
2. Needs extra attention because of wilful naughtiness or resistiveness.
3. Docile and easily managed or occasionally naughty.
4. Rarely naughty.

V Over-activity-Apathy

1. Constantly 'on the go'.

2. Occasional episodes of over-activity.
3. Not over-active.
4. Apathetic and sluggish—a lazy child.

VI Destructive—Not destructive

1. Destructive behaviour causes a problem in management.
2. Occasionally destructive.
3. Not usually destructive.
4. Very rarely destructive.

VII Rigidity—Adaptability

1. Obsessional behaviour marked (i.e. always wanting to do the same things at the same time or place).
2. Continuing disturbance after change.
3. Unhappy about change but settles quickly.
4. Seems undisturbed or unaware of new situation.

VIII Independence—Timidity

1. Adventurous in strange situations.
2. Only adventurous in familiar situations.
3. Willing to explore but needs reassurance.
4. Cautious and anxious in new situations.

IX Irritability—Affability

1. Easily upset. Frequent temper tantrums or sulks for long periods.
2. Moody only when cannot get own way.
3. Accepts correction and frustration with only slight upset.
4. Even tempered and never seems frustrated.

X Obstinacy—Amenability

1. Actively refuses to co-operate in routine tasks (daily occurrence).
2. Frequently refuses to co-operate but easily overcome by persuasion.
3. No apparent wish to please but conforms easily.
4. Is helpful and wishes to please.

CLINICAL AND LABORATORY DATA

Pregnancy and delivery

Milestones

Smiled

Sat unsupported

Stood holding on

Walked alone (2 steps)

Managed cup and spoon

Toilet training

Age started

Age completed

Maternal attitude (describe)

Present status

Episodes of diarrhoea or constipation

Speech

First words

Present status

Any special help given?

Feeding

Infancy:

Schedule—demand or clock

Breast or bottle

Use of oral comforters

Solids started

Any early problems

Food fads

Appetite

Sleeping (including any problems at night)**Convulsions** (including drugs for convulsions)**Physical illnesses, accidents and accidental poisoning** (state duration of time in hospital)

Major

Minor

Medicine given (in particular, iron)**Behaviour problems**

Have there been any behaviour problems in the past?

Are there any behaviour problems at present?

Laboratory recordings and physical examination of child

<i>Date</i>	<i>Height</i>	<i>Percentile</i>	<i>Weight</i>	<i>Percentile</i>

Haemoglobin:

Blood film:

EEG:

Blood lead levels:

X-rays:

Abnormal clinical findings:

Data for control sibling

Name:

Age:

Intellectual level:

Presence of handicaps or behaviour problems:

Illnesses:

Major

Minor

Operations:

Accidents:

Poisoning:

Use of comforter:

Introduction of solid food:

Early feeding difficulties:

Sleeping difficulties:

SUMMING UP: SUBJECT DATA

Enumerate factors present at onset of pica:

Internal

External

Factors present at cessation of pica:

Internal

External

If pica still continuing, what factors have not altered?

Internal

External

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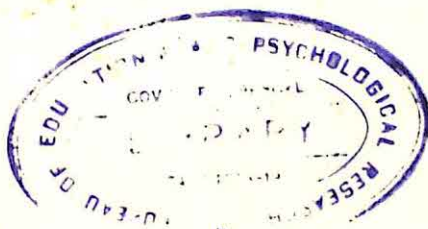
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PICA

A Childhood Symptom

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Pica — the ingestion of and desire to ingest substances usually considered inedible — is a dangerous symptom because of the complications of poisoning and intestinal obstruction.

This monograph is the result of Dr. Bicknell's investigations made of 15 children, referred to her by various medical and social agencies because of pica. The numbers were small to permit the study to be intensive rather than extensive. While it was not possible to use controls, where relevant the children were compared with the sibling closest to them by age and standard control values are given where appropriate.

A complete case history was obtained with a semi-structured interview technique, usually during home visits; the child was examined carefully and psychometric assessments and other paramedical reports were obtained. Special examinations such as an ECG, abdominal radiograph and analysis of chewed objects for lead were undertaken where necessary. Blood lead and haemoglobin estimations were done as often as needed. Collateral and retrospective information was obtained from social agencies, school reports and health visitors involved in family care. The wealth of information to be gained from Dr. Bicknell's study, augmented by her review of the literature and her conclusions and indications for future work, will be welcomed by all concerned with the study, treatment and care of children with pica.

Contents:

- The Aims of the Study
- Review of the Literature
- Methods
- Pica in the Severely Subnormal Child
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